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REPRODUCTIVE BIOLOGY OF THE MOURNING DOVE, ZENAIDURA MACROURA, IN SOUTHERN ALBERTA

(C)

BY

BRUCE CORNEILLE SWITZER

A THESIS SUBMITTED TO THE
FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

DEPARTMENT OF ZOOLOGY
EDMONTON, ALBERTA

FALL, 1970

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Thesis
1970 F
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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Reproductive Biology of the Mourning Dove, Zenaidura macroura, in Southern Alberta". Submitted by Bruce Corneille Switzer in partial fulfilment for the requirements for the degree of Master of Science.

ABSTRACT

One hundred and fifty-four mourning dove nests were found and followed to completion at Coaldale, Alberta in 1967 and 1968. Mourning doves arrive during the first week of May and begin nesting about two weeks later. The onset of clutch initiation is influenced by minimal environmental temperatures above 35°F. and foliage condition may influence site selection early in the breeding period. The peak of the breeding period occurs during the second week of June and nests initiated before the first week of July are mainly first attempts and those after this date mainly renesting attempts.

Fifty per cent of the nests found were in western cottonwoods, Populus sargentii. Other trees used were narrow-leaved cottonwoods, P. angustifolia, lance-leaved cottonwoods, P. acuminata, and peach-leaved willows, Salix amygdaloides. Ground nests constituted 14% of all nests found.

Nests were located in parts of the study area which were generally open, with a light understory, and near the periphery of wooded areas.

The preferred height of tree nests was around 10 feet, and the preferred nesting position was on top of limbs.

Reproductive success was 64% in 1967 and 48% in 1968. Total reproductive success was 55% for both years. Ground nests were more successful than tree nests with a

total reproductive success of 79% as opposed to a total reproductive success in tree nests of 51%.

The major cause of nest failure was predation, with 71% of clutch failures occuring in the egg stage and 29% in the nestling stage. Weather caused 12% of all nest failure, mainly through hypothermia.

The height, position of nest, or amount of cover could not be related to reproductive success.

In 1967, each pair nested 1.4 times and produced 1.8 fledglings, and in 1968 each pair nested 1.7 times and produced 1.6 fledglings. Productivity of a theoretical population was calculated using these data, and in both years natality could not compensate for yearly mortality.

It is, therefore, concluded that at latitudes of 50° and north, the breeding season is so shortened that additions to the population cannot compensate for yearly mortality, and that no Alberta population of mourning doves could be self-sustaining.

It is further concluded that a hunting season on mourning doves at these latitudes is not within the concepts of wise game management.

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INTRODUCTION

Historically the mourning dove, Zenaidura macroura, was probably most abundant in the southeastern United States. However Peters (1961) feels that westward expansion of agriculture has favored the dove, probably by creation of ecotones (Odum 1959), and although current land use practices are detrimental to many species, Gallizioli (1961) feels that the dove is an exception. Consequently the mourning dove is more abundant today, and currently it is the most common and widely distributed of 12 species of indigenous North American Columbidae (Bent, 1932; Goodwin, 1967).

Mourning doves breed across southern Canada, throughout continental United States and Mexico, and winter in the middle states to Central America (Goodwin, 1967). In Alberta the mourning dove nests mainly throughout the prairies in wooded coulees and riverbottoms and in the lightly wooded parklands (Salt and Wilk, 1958). However it could only be termed a common summer resident south of the 50th parallel.

Peters (1961) reports that mourning dove nests containing eggs have been found throughout the year in the southern-most United States, however he states that most of the breeding occurs between April and September. It is well documented that mourning doves are capable of nesting more than once per season, and that completion of one clutch, that is from laying of the first egg to fledging of the last nestling, takes approximately one month. The number of

attempts per pair varies with latitude and appears to be limited by the length of the breeding season which is in turn determined by spring weather and fall migration. Quay (1954), and Hanson and Kossack (1963) feel that a cold wet spring can delay spring arrival and subsequently the onset of breeding. Obviously factors causing fall migration would terminate breeding. As a result Quay (1954) found that five attempts per pair were not unusual on the southern range in the United States and Fitcher (1959) says that three attempts probably represent the maximum on the northern range in the United States.

Burns (1921) states that from the point of view of clutches, the mourning dove is the most productive nidicolae, being hormonally capable of reproduction for a prolonged period, adapted to varied and seasonally abundant foods, and having a brief nesting cycle. Moreover Peters (1961) reports that a variety of rural and urban nesting habitats are utilized, both in trees and on the ground. Other factors contributing to its success and wide distribution were elucidated by Bartholomew and Dawson (1954) who found that adults can exist for four to five days without water of succulent vegetation. Also the male assists with incubation and brooding.

In Georgia, Hopkins and Odum (1953) found that mourning doves did not as a rule tend to nest in colonial or semi-colonial nesting concentrations, while studies conducted

in the western United States indicate that nesting concentrations are usually found. Hopkins and Odum (1953) feel that in the west, nesting habitat is limiting since the dove here tends towards colonialism while in the east, where habitat is often continuous, nests are scattered throughout.

As a consequence of abundance, wide distribution and high productivity, combined with good sporting qualities, the dove is a popular game bird in 30 states and one province. In fact Peters estimated in 1961 that the annual harvest in the United States was approximately 30 million doves. If this estimation is correct the mourning dove is perhaps the most important game bird in the United States.

In Alberta mourning doves have not been legally hunted, however in recent years the Calgary and Lethbridge Fish and Game Associations have asked for a hunting season. One of the central questions therefore was; would a hunting season in Alberta be within the concepts of wise game management, and is a harvestable surplus annually available to the hunter? Since no intensive work has been done on mourning doves in Alberta, the major task of this project was to determine some aspects of breeding biology and population dynamics pertinent to resolution of this question.

As southern Alberta is part of the mourning doves northernmost range, reproductive success becomes of special interest, since Goodwin (1967) and others, feel that the dove evolved in semitropical regions. Presumably then its

evolution has been in response to this environment. This species has evolved the ability to successfully rear more than one clutch per year with a short nesting cycle for each clutch. On the other hand the mourning dove usually builds frail, exposed nests, lays white eggs, and does not have a brood patch. These last factors must not have been a disadvantage in a semi-tropical environment or else were negated by a long breeding season.

However, the mourning dove has expanded its range northward into temperate regions and the breeding season is progressively shortened with increasing latitude. Therefore each pair is capable of producing fewer clutches per season. If one assumes that mortality is more or less constant, south to north, there must be some critical latitude where the breeding season is so shortened that the number of successful attempts cannot compensate for yearly mortality. This critical latitude will be determined by reproductive success. A high reproductive success would allow establishment of breeding populations further north than a low one. The obvious question is, does a shortened breeding season act as a limiting factor with regard to distribution of mourning doves?

It appears that food and habitat are not limiting in Alberta because the dove is graminiverous and seeds are as available in spring as in fall, their availability being only reduced by snowfall. Moreover the sporadic distribution

of doves in Alberta would indicate that habitat is not limiting as many areas which appear to be suitable are devoid of doves or only a few pairs are present.

The objectives of the study were to determine; breeding chronology, including time of arrival, onset of nesting, length of the breeding period, and time of departure from the breeding ground, nesting habitat, including nesting sites and factors influencing their selection, reproductive success and factors influencing it at different times of the breeding season, in different nesting habitats and on different sites.

Southern Alberta was selected for the study since Salt and Wilk (1958) show the mourning dove to be most common in this region.

It was necessary to find a site where doves were abundant in order to secure quantitative data. Such a population may not be representative of densities throughout Alberta, however time factors precluded an intensive study on a larger scale.

Ideally the most suitable population would be centrally located in the area, discrete from other nesting populations and with enough breeding pairs to provide adequate data to fulfill the objectives of the study.

Initially southern Alberta was surveyed south of the 51st parallel. It became quickly evident through per-

sonal communication with residents and through observation that the only areas where such a population existed was in wooded river bottoms with adjacent cultivated fields. Consequently the search was confined to these areas in the Eastern Irrigation District and a study area was located on May 18, 1967.

THE STUDY AREA

The Oldman River is one of five major drainage systems of southern Alberta. The others are the Red Deer, Bow, South Saskatchewan and Milk Rivers. Valleys created by these rivers provide protection from prevailing winds and are closer to the water table, creating situations where trees may become established. Consequently these river valleys contain the only extensive naturally occurring woodlands, outside of the Cypress Hills, on the Alberta prairies. The forested coulees and river bottoms are characterized by a particularly rich fauna caused by the "edge effect" of intergrading forest and prairie (Odum 1959).

The study area is on the south shore of the Oldman River, 13.3 miles N.N.W. of Coaldale, Alberta and is legally described as Sections 33 and 34, Township 10, Range 19, west of the 4th Meridian. The climate of the Eastern Irrigation District, of which the study area is part, is described by Keith (1961) as being characteristically semi-arid, located as it is in the rain shadow of the Rocky Mountains, and with warm dry prevailing winds. The mean annual precipitation is nine inches of rain and 39 inches of snow. The geographical relationships of the area are shown in Figure 1.

As recently as 1914 the study area was an island (Anon., 1914). However the northern channel has gradually

FIGURE 1. Map and photograph of the study area, at Coaldale, Alberta showing the probable recent course of the Oldman River.

Oldman River
N
Northern Channel in 1914
Southern Channel in 1914
STUDY AREA
0 200 600 1200 Feet

moved northward since that time, becoming the main channel of the river, the southern channel is now dry, creating a more or less "U" shaped alluvial river bottom, Figure 1, approximately 150 feet below the surrounding prairie.

It is highly likely that the change from an island to a river bottom has had an influence on vegetation and thus bears description here. The point at which the river divided was undoubtedly due west of the southern most extension of vegetation. From this point the southern channel ran due west to the present southern border of the treed area and thence followed the southern and eastern borders of the treed area and emptied into the present channel at the point marked on Figure 1. The old channel still exists although it is overgrown with vegetation and in places filled in with loess. The earlier position of the northern channel is less easily delineated since it has been gradually progressing north. However its probable position is shown in Figure 1. It is certain that the northern most 140 acres of the study area were not part of the island since the 1914 records show them on the north side of the river. This change is pertinent in terms of species composition of the overstory since the southern part of the study area is older than the northern portion in terms of vegetational growth.

The surface geology of the area bears some description since it influences the nature of the soil. Russell

and Lands (1940) describe the area as being of the Oldman formation, which is upper Cretaceous in age, composed of light colored shale and sandstone. Outcroppings of this formation are evident in the coulees surrounding the area and provide habitat for a variety of denning animals such as coyotes, Canis latrans, porcupines, Erethizon dorsatum and rattle snakes, Crotalus viridis. The top soil of the study area is generally sandy and shallow overlying gravel deposits which are particularly evident in the western part of the area.

The study was restricted to the wooded area although a buffer strip of approximately 100 yards was included to the south of this area (Figure 1). This area is more or less circular in shape surrounding a large centrally located opening and a smaller more westerly opening. The entire area is 600 acres in size and excluding the two openings is 350 acres in size.

The predominate trees of the area are the western cottonwood and the narrow leaved cottonwood, the former occurring most commonly in the area bordering the old southern channel and the latter predominating the remainder of the area. Less common but occurring throughout are the lance-leaf cottonwood and the peach-leaved willow. Other vegetation which commonly extends into the overstory (overstory being defined as woody perennials above breast height), are vines, Clematis ligusticifolia, hawthorn, Crataegus

chrysocarpa, saskatoon, Amelanchier alnifolia, choke cherry, Prunus virginiana and willows, Salix spp., the latter being particularly common in the N.E. corner of the old channel which may be inundated each spring.

The middle story (middle story being defined as woody perennials below breast height and above 25 cm.), is composed of new growth of all of the above however where it exists it is predominated by roses, Rosa acicularis and R. woodsii and by buck brush, Symphoriocarpos occidentalis. Generally the middle story is light, but in some areas notably the N.E., an association exists between buck brush, roses and hawthorns to such an extent that it is impenetrable.

The understory (understory being defined as annuals, biennials, herbacious perennials, and woody perennials below 25 cm.), is dominated by grasses, chiefly Poa spp. and Stipa spp. Although annual weeds are common in grazed areas and sweet clover Melilotus alba and M. officinales are common in the small openings of the area.

The large central opening is prairie-like consisting of grasses and annual weeds with a few interspersed cottonwoods and patches of roses and buck brush.

Land use of the area is not intensive and grazing is restricted to the east half and then only for a few months of the year. Some gravel excavation is done in the S.W. corner of the central opening which is confined to a small pit which fills with water in the spring.

Avifauna of the area is rich, with more than 40 resident species during the summer, which are tabulated in the appendix. Resident mammals include white-tailed deer, Odocoileus virginianus, mule deer, O. hemionus, porcupines, Erethizon dorsatum, skunks, Mephitis mephitis, long tailed prairie weasels Mustela frenata, white-footed deer mice, Peromyscus maniculatus meadow voles, Microtus pennsylvanicus, pocket gophers, Thomomys talpoides, and the big brown bat, Eptesicus fuscus. Reptiles include the prairie rattlesnake, Crotalus viridis, bull snake, Pituophis melanoleucus and garter snake, Thamnophis sp.

METHODS

In 1967 field work commenced on June 1 and terminated on September 17. In 1968 work commenced on April 30 and terminated on September 14. Additional observations were made on March 7 and 8, 1969.

Weather

Temperatures were recorded with two maximum-minimum thermometers, one located in an area known to be heavily used by nesting mourning doves and one in an area not so used the previous year. Rainfall was recorded with a rain gauge located centrally in the study area.

Reproductive Biology

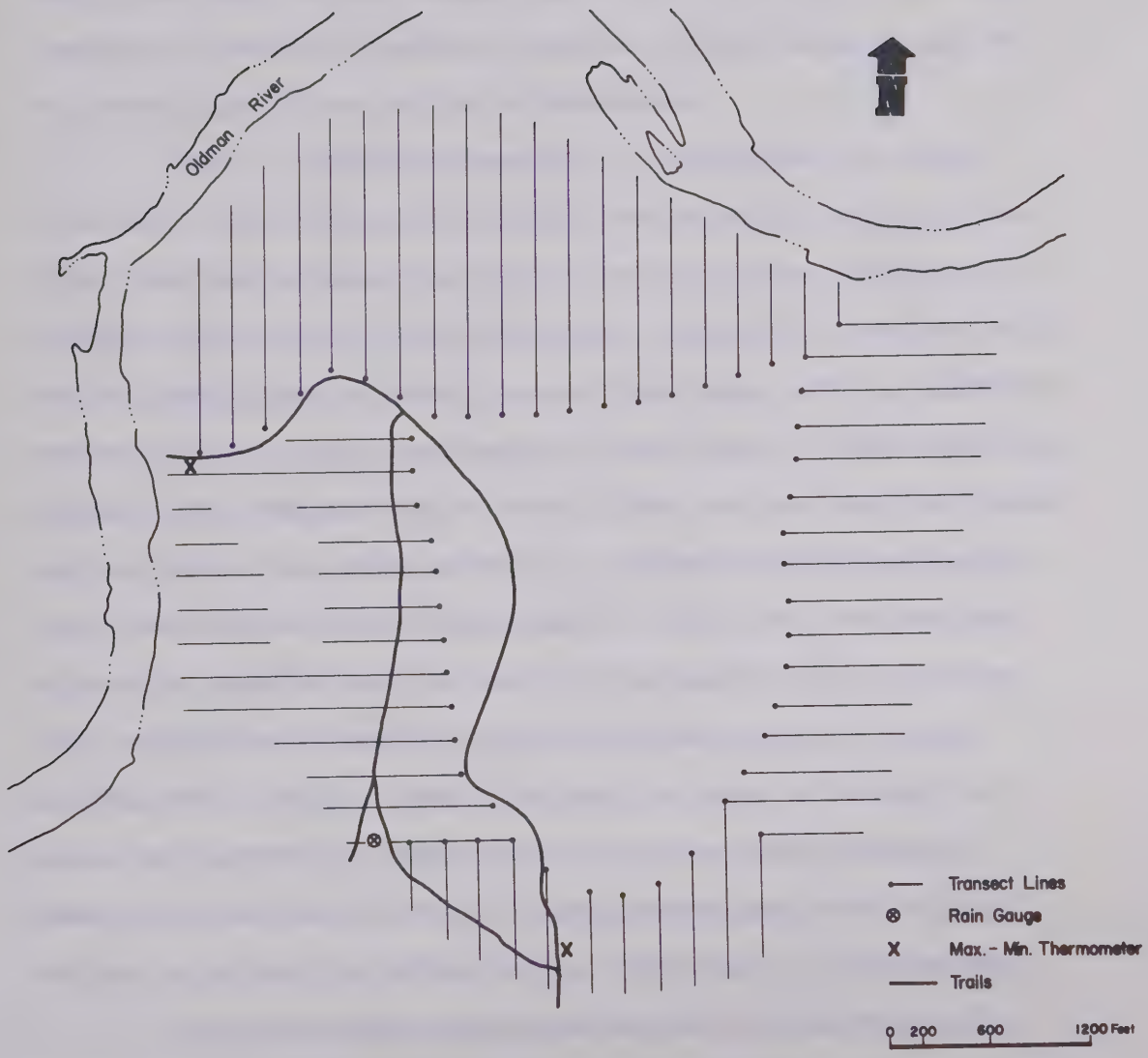
The study area was thoroughly searched for nests once per week. To facilitate location and mapping of nesting sites 59 transects 200 feet apart were run in the forested portion of the study area. The position of the transects and the stake marking the beginning of each one is shown in Figure 2. Each transect line was marked with stakes 200 feet apart. The stakes used were three feet in length and were made noticeable with blaze orange plastic tape. Nest searches were conducted back and forth in a zig-zag fashion between two transect lines, the area covered by one line between two transects was arbitrarily determined on the basis of density of vegetation. When a nest was found the tree containing it was marked with blaze orange tape to simplify relocation. In 1967 the tree trunk was numbered with a grease pencil and in 1968 the tape was numbered with indelible ink.

Both techniques proved impervious to weather. To reduce the possibility of attracting predators the marking tape was never placed near a nest. Thus, if a nest was low or particularly exposed the marker was placed on nearby vegetation in such a manner that the nest was not visible from that point and yet the marker could be readily seen for purposes of relocation. A new nest was mapped by measuring distance along a north-south and east-west line to the nearest stake which marked a transect line. That is a north-south, east-west right angle was run with a compass, using as a reference point a transect stake whose location was previously mapped. If a previously located nest was closer this procedure was repeated only using the known nest as a reference point. Height of each nest was measured using a steel tape measure or Abney level.

The history of each nest was recorded on nest record cards which included the following data; nest number, date, time of discovery, location number and age of eggs and/or nestlings, species and height of tree, position and height of nest, composition of nest, nature and percentage of cover, daily history of the nest and any other pertinent information such as behavior or cause of failure.

Nests were revisited each day and the nestlings were banded between day three and five with size 3A bands supplied by the U.S. Fish and Wildlife Service. At this age the band will slip off the foot. However, using a

FIGURE 2. Location of weather recording equipment and transect lines.


Oldman River
N
Transect Lines
Rain Gauge
Max. - Min. Thermometer
Trails
0 200 600 1200 Feet

technique devised by Hanson and Kossack (1963) the band is secured to the upper part of the tarso-metatarsus by a piece of medical adhesive tape. The band is thus secured until the foot is too large for it to slip off. The tape eventually wears off and no adverse effects were noted on any nestlings by use of this technique.

Data on nesting phenology is expressed in terms of clutch initiation, that is if the date of laying of the first egg was unknown the clutch or brood was backdated to the day of laying of the first egg. Eggs were candled with a nine inch piece of black rubber hose one inch in diameter, one end of which was cut away to form a cup. The elasticity of the hose enables one to cradle the egg against the cupped end and mould the hose around it. When held up to the sun and viewed through the other end of the hose, the egg may be easily candled and the age of the embryo can be estimated using developmental criteria established by Hanson and Kossack (1963). Nestlings may be aged up to day ten using developmental characteristics also established by Hanson and Kossack (1963). These techniques enable backdating of a nest to within one or two days of initiation.

Since mourning doves are exposed to terrestrial as well as aerial predation, percentage cover of tree nests was estimated through a sphere surrounding the nest, three feet in diameter. Cover of ground nests was estimated through a hemisphere over the nest, three feet in diameter.

Percentage cover was then converted to an index as follows:

0 - 5% cover = 1

6 - 25% cover = 2

26 - 50% cover = 3

51 - 75% cover = 4

76 - 95% cover = 5

96 - 100% cover = 6

Since cover changes with vegetational maturation, estimations of cover were made at the following times; when the nest was found, when hatching occurred and when fledging occurred. If the nesting attempt was unsuccessful cover was recorded at that time. The data presented on nest cover is an average of these observations for each nest, since presumably the nest was subject to predation throughout the period of its occupancy.

Vegetational Analysis

The overstory was sampled for frequency, abundance and density of the species composing it. Frequency is defined as the percentage of sample plots in which a given species occurs. It is obtained by dividing the number of plots in which the species occurred by the total number of plots and multiplying by 100. Thus an estimate of the frequency occurrence and distribution of species is obtained, factors which are important in delineating the comparative relationship of species in the vegetation (Phillips, 1959). Abundance is defined as the relative

numbers of individual species in the study area and is obtained by totaling the number of species in all plots and expressing this in a table from most abundant to least abundant. This data may also be expressed as density which is the average number of individuals per sampled area or per unit area and is obtained by adding the total number of each species for the total sample area and dividing by the total sample area in square meters, giving an expression of each species per square meter. The understory and middle story were not quantitatively examined, but in areas where these strata figured prominently as nesting sites the species composing them were identified and abundance was subjectively determined. Otherwise only the prominent genera of these strata were considered. All plants were identified through the use of the Flora of Alberta (Moss, 1959).

Sampling of trees composing the overstory was done systematically since variations within a stand are more likely to be included in a systematic sample than in a random one (Phillips, 1959). Admittedly the advantage of statistical analysis is lost in a systematic sampling technique (Phillips, 1959), however the objectives of the vegetational analysis, that is, relationships between variation within a stand and nest site selection, outweigh this disadvantage.

Transect lines on which samples were taken were

along transects used in nest location and on transects parallel to those used for nest location running through the center of each area delineated by two nest transects, that is each vegetation transect was 100 feet apart. Samples were taken at 100 foot intervals along each transect. All of the transects were treated as though they were in a straight line, that is, if a sample was taken 30 feet from the end of a transect the next sample was taken 70 feet from the beginning of the next transect. Distances were measured with a rope 100 feet in length which was found to be more convenient than a steel tape measure.

The technique used at each sample plot is that of Raunkiaer (1934), as described in Phillips (1959). In this method a stick two meters long with an attached cord is used and the area of the rotated cord encompasses ten meters. At each plot the stick is thrust into the ground and the cord rotated horizontally through 360 degrees. The number and species of all trees encountered within this circle and which are in the overstory are recorded. At each plot a qualitative analysis of the middlestory and understory was also made.

Nesting Cones

Artificial nesting platforms have been erected in Ohio by Calhoun (1948) and their use by doves analyzed. This technique involved erection of nesting cones approximately nine inches in diameter and two to three inches

deep made out of roofing paper. If nesting sites are a factor limiting numbers of nesting doves, erection of suitable substrate should increase the number of nesting pairs or else nesting cones would be selected in preference to other less suitable sites. In this project the same cone dimensions were used except the cones were made of hardward cloth of ¼ inch mesh. When erected the split along the radius is overlapped forming a cone two to three inches deep. This is nailed to the desired substrate on top of a limb or between a crotch formed by two limbs.

One hundred cones were erected throughout the study area in 1968. They were placed on five transects, 20 on each. The transects were located in areas known to be used by doves the previous year. The cones were erected at distances of approximately 10, 20, 30, 40, and 50 feet on each transect respectively. They were placed at various heights, depending on the nature of the selected tree, however most were placed between eight and ten feet from the ground. An attempt was made to evaluate cover, and place the platform in a site similar to those of the previous year.

RESULTS

Arrival on Breeding Grounds

In 1967 arrival occurred prior to location of the study area, consequently exact dates are unknown for that year. In 1968 one male was seen and heard on April 30 and on May 3 at least three males were present. Hereafter birds began to arrive rapidly and the bulk of the breeding population was present by the third week of May since after this date there did not appear to be an increase in the number of adults present.

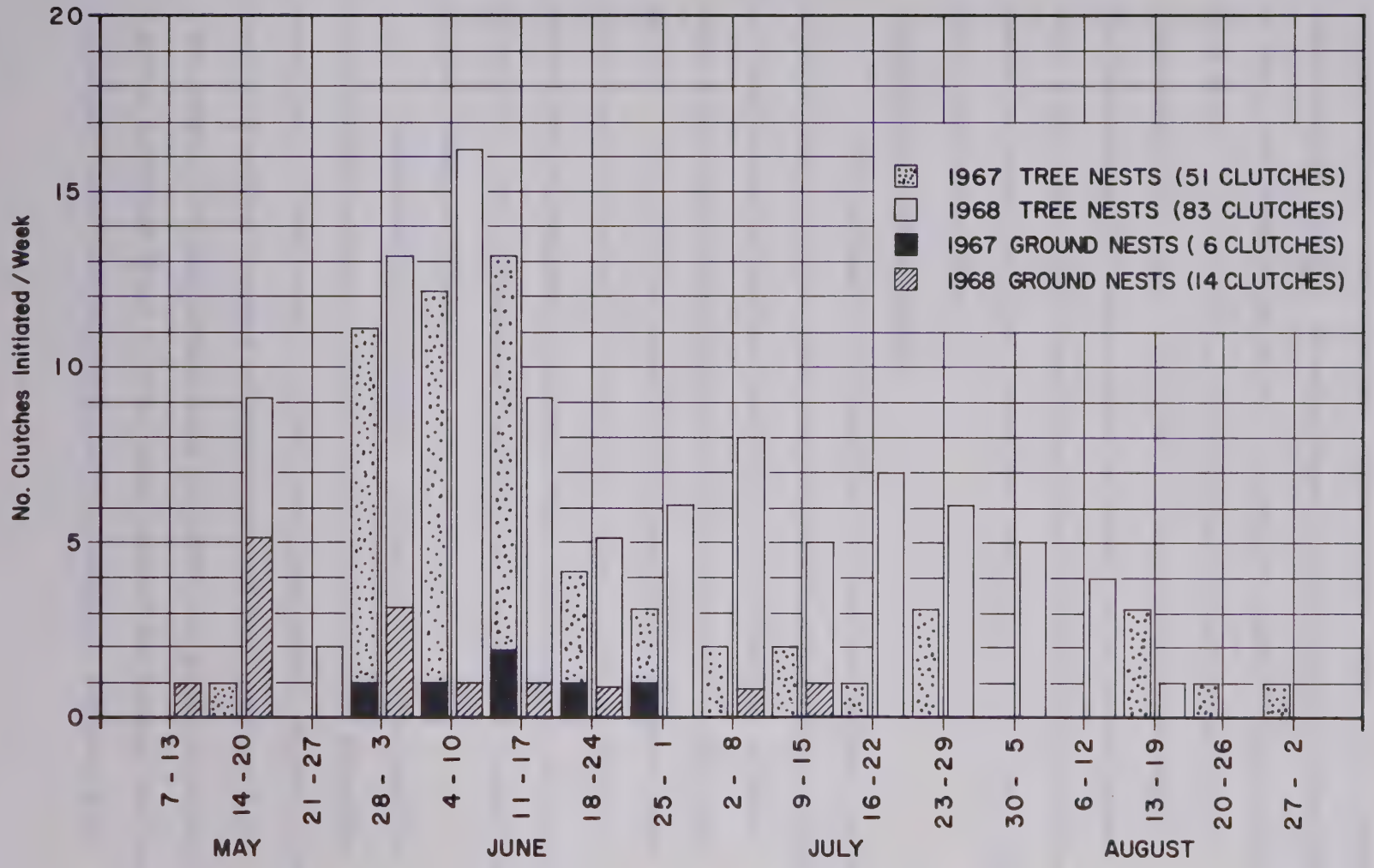
The time of arrival and subsequently the onset of breeding are probably functions of spring weather. Quay (1951) feels that spring weather may delay nesting and this is corroborated by Hanson and Kossack (1963) and Swank (1955). As may be seen in Figure 3 the first major week of clutch initiation in 1967 began two weeks later than in 1968. This is attributed to the unseasonally late snowfall of 1967, Since nesting was delayed that year it is likely that arrival was delayed about the same length of time by the same factor.

Clutch Size

One hundred and fifty four mourning dove nests were located and observed for the duration of their occupancy. Fifty seven were found in 1967 and ninety seven in 1968.

It is well documented that mourning doves typical-

FIGURE 3. The number of clutches initiated per week for 154 mourning dove nests at Coaldale, Alberta, during 1967 and 1968.


No. Clutches Initiated / Week
20
15
10
5
0
1967 TREE NESTS (51 CLUTCHES)
1968 TREE NESTS (83 CLUTCHES)
1967 GROUND NESTS (6 CLUTCHES)
1968 GROUND NESTS (14 CLUTCHES)
7 - 13
14 - 20
21 - 27
28 - 3
4 - 10
11 - 17
18 - 24
25 - 1
2 - 8
9 - 15
16 - 22
23 - 29
30 - 5
6 - 12
13 - 19
20 - 26
27 - 2
MAY
JUNE
JULY
AUGUST

ly lay two eggs per clutch, (Nice, 1922; Quay, 1951; Hanson and Kossack, 1963). However most workers report clutches of one and three eggs also. As may be seen by inspection of Table 1 this was also true in this study with 96.1% containing two eggs, 3.3% one egg and 0.6% three eggs. The percentage of nests with two eggs is in close agreement with Quay (1951) who found that 95.23% of 1,045 dove nests in North Carolina contained two eggs, 4.13% one egg and 0.64% three eggs.

Initiation of Egg Laying

For purposes of comparing initiation of egg laying between the 1967 and 1968 populations the breeding period is considered to be that period from initiation of the second and subsequent clutches to initiation of the last clutch. In 1967 the second and subsequent clutches were initiated in the week of May 28 - June 3 and in 1968 the second and subsequent clutches were initiated in the week of May 14 - 20. Consequently breeding began two weeks later in 1967 than in 1968.

Examination of Figure 3 reveals that the peak of the breeding period in 1967 was of a three week duration, occurring in the fourth, fifth and sixth week, after which nest initiation dropped sharply and did not exhibit another peak. On the other hand in 1968 the peak of breeding was extended over a five week period beginning during the second week and tapering off to exhibit another but

TABLE 1. Clutch size of 1540 mourning dove nests at Coaldale, Alberta in 1967 and 1968.

Clutch Size	Number	Percent
1	5	3.3
2	148	96.1
3	1	0.6

TABLE 2. The percentage of clutches initiated per triad in 154 mourning dove nests at Coaldale, Alberta in 1967 and 1968.

	Triad of the Breeding Period		
Year	May 7-June 17	June 18-July 29	July 30-Sept. 9
1967	64 n = 37	26 n = 15	10 n = 5
1968	52 n = 50	38 n = 37	10 n = 10
Total	56 n = 87	34 n = 52	10 n = 15

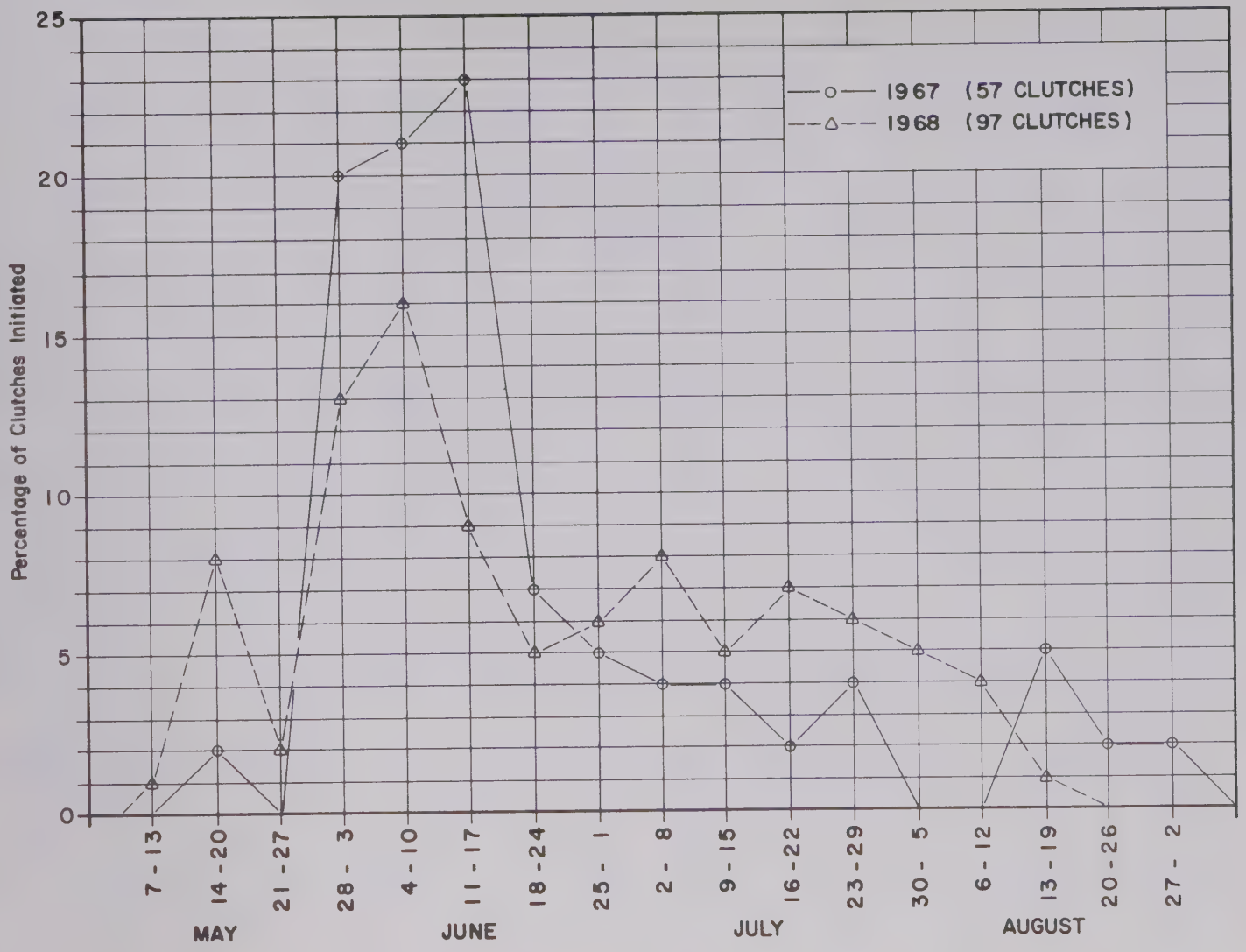
less intense peak during weeks nine, ten and eleven. It may be noted in Figure 4 that the frequency of clutch initiation was greater during the breeding peak of 1967 than 1968. Consequently as shown in Figure 5, the cumulative percentage of clutches initiated during the peak of the nesting season in 1967 was greater than 1968.

Analysis of these data has been facilitated by dividing the breeding season into six week triads, viz. May 7 to June 17 (spring), June 18 to July 29 (early summer) and July 30 to Sept. 9 (late summer).

The percentage of clutches initiated each year in these periods is shown in Table 2. As may be noted the first triad of the breeding season is most important in terms of clutch initiation. Moreover as may be seen in Figure 4 the peak of the breeding season is reached during this period. However it is important to keep in mind that in terms of production the relative importance of each period is only relevant when considered in terms of reproductive success.

The "key week" of the breeding period is considered to be that week during which the rate of clutch initiation began to increase sharply. The significance of establishment of a key week lies in determining the influence that weather plays on the onset of breeding. The importance of weather in breeding is elucidated by Kendeigh (1941) who discusses the significance of food

FIGURE 4. The percent frequency per week of 154 mourning dove clutches, initiated during successive weeks of the breeding season in 1967 and 1968 at Coaldale, Alberta.


25
20
15
10
5
0
Percentage of Clutches Initiated
1967 (57 CLUTCHES)
1968 (97 CLUTCHES)
7 - 13
14 - 20
21 - 27
28 - 3
4 - 10
11 - 17
18 - 24
25 - 1
2 - 8
9 - 15
16 - 22
23 - 29
30 - 5
6 - 12
13 - 19
20 - 26
27 - 2
MAY
JUNE
JULY
AUGUST

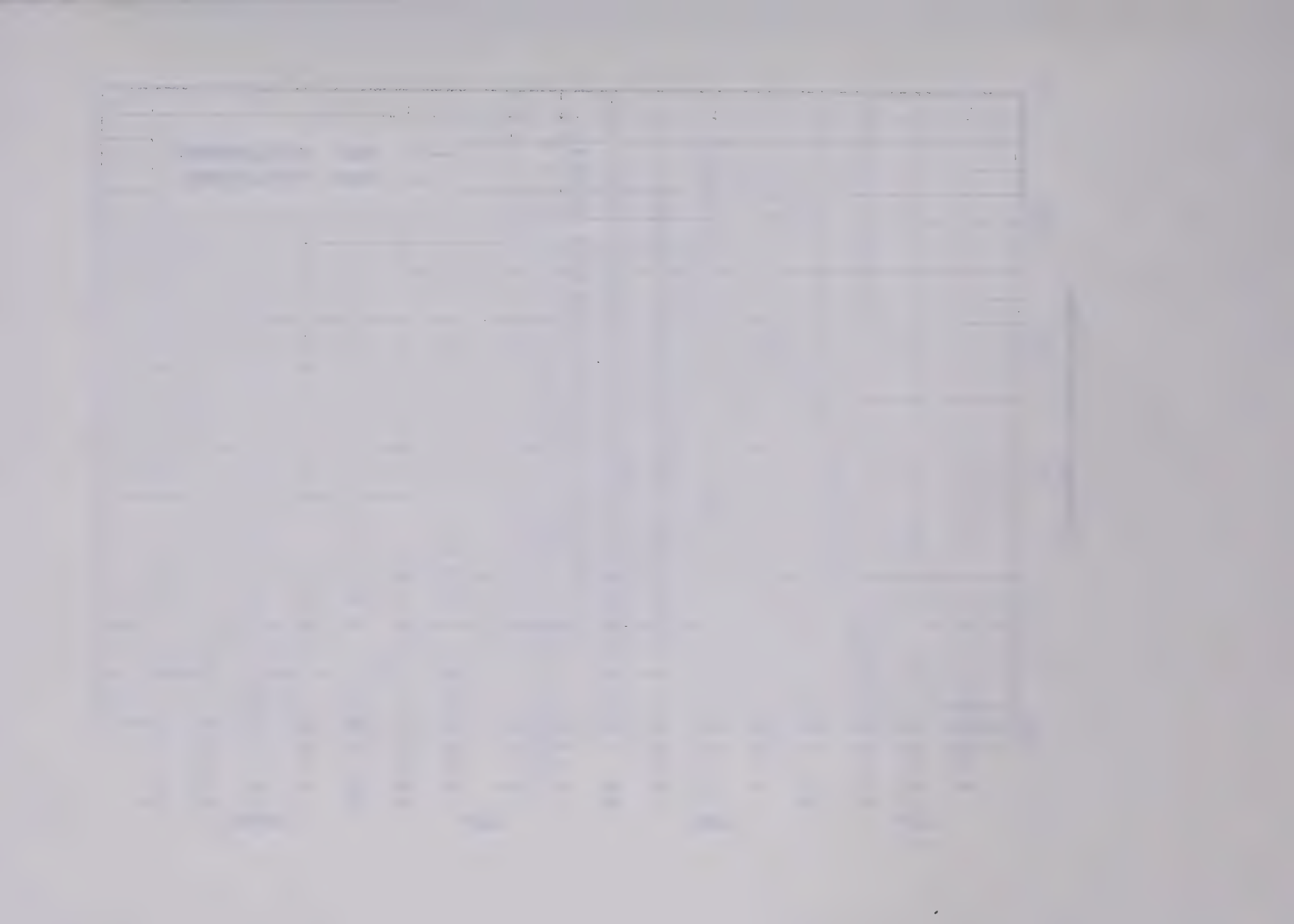
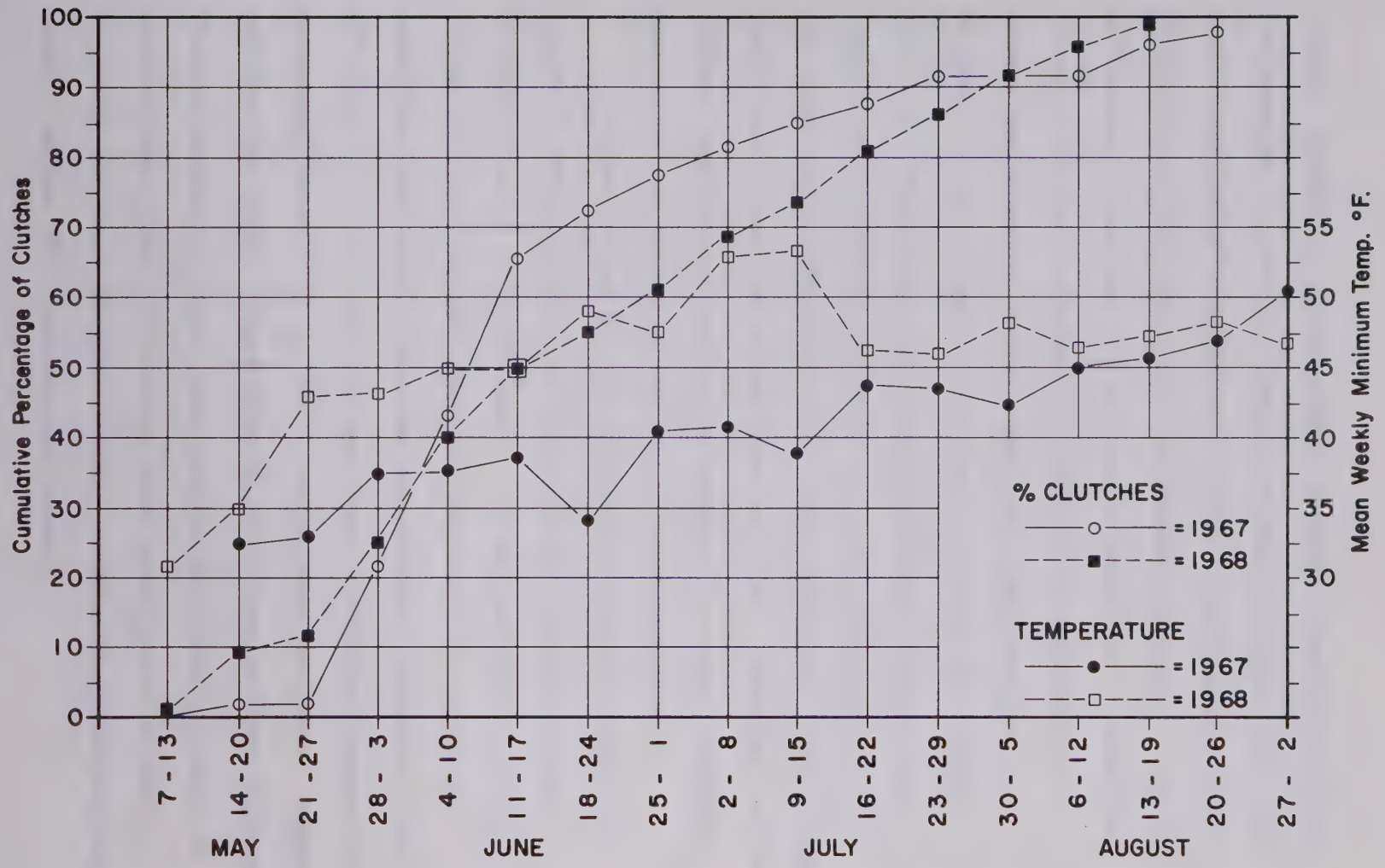


FIGURE 5. The percent cumulative initiation of 154 mourning dove clutches in successive weeks of the breeding season in 1967 and 1968 at Coaldale, Alberta; illustrating the mean weekly minimum temperatures in ^{o}F. and the key week of the breeding season.


Cumulative Percentage of Clutches
Mean Weekly Minimum Temp. °F.
100
90
80
70
60
50
40
30
20
10
0
55
50
45
40
35
30
% CLUTCHES
= 1967
= 1968
TEMPERATURE
= 1967
= 1968
7 - 13
14 - 20
21 - 27
28 - 3
4 - 10
11 - 17
18 - 24
25 - 1
2 - 8
9 - 15
16 - 22
23 - 29
30 - 5
6 - 12
13 - 19
20 - 26
27 - 2
MAY
JUNE
JULY
AUGUST

intake, length of photoperiod, minimum temperatures, and the resultant lack or surplus of energy beyond that required for daily maintenance, since a surplus of engergy is necessary for ovulation and spermatogenesis. The significance of weather in initiating breeding in mourning doves is further obvious in light of an argument of Hanson and Kossack (1963), who feel that availability of food is not a factor limiting the onset of nesting, since the availability of seeds produced the previous year is no different in early or late spring except in the event of a late snowfall. They also feel that foliage condition of nesting sites does not limit breeding, which further implicates weather as perhaps the most important factor in the onset of nesting in mourning doves.

Examination of the cumulative nesting curves in Figure 5 reveals that the key week was the third week, or May 21 to 27 in both years. It may be noted in Figure 5 that in 1968 the key week was preceded by a week in which the mean weekly minimum temperature increased from 30° to 46° F. In 1967 the mean weekly minimum temperature increased from 26° F to 35° F during the key week. Hanson and Kossack (1963) found that in 632 mourning dove clutches studied during an eight year period in Illinois, only an insignificant rate of nesting took place prior to each key week and that the mean weekly minimum temperature was usually below 37° F before each week.

In this study in 1968 the key week did not occur until after the mean weekly minimum temperature had risen to this point and in 1967 the key week occurred during the week when this temperature rose to 35° F.

MIGRATION

At the end of July, the juveniles, identifiable by white tipped primary wing coverets, begin to flock, and by mid-August one large flock was present in the central part of the study area. Migration of this flock from the study area occurred during the third week of August in both years.

Adults begin to flock towards the end of September and migration begins during the second week of September, presumably juveniles from late nesting attempts leave at this time also.

NESTING

Nest Construction

Nice (1922) found that as a general rule nest construction takes place in the early morning with the male collecting nesting material one piece at a time and bringing it to the female at the nesting site where she arranges it. In this study five nests were observed under construction and in all cases construction occurred between 5:45 A.M. and 10:30 A.M. Although it was not always possible to observe where the male collected nesting material, generally it was not far, and usually less than 50 yards from the nesting site.

Tree nests were characteristically frail and frequently eggs could be observed through the bottom of nests. Ground nests were usually in shallow depressions and noticeably less nesting material was used than in tree nests. Typical tree and ground nests are illustrated in Figures 6 and 7.

Nesting material was estimated and the major components of 101 nests tabulated. The frequency occurrence of the major nesting materials can be expressed as follows, grasses 75%, twigs 64%, cudweed, Gnaphalium palustre, 7% and tumbleweed, Amaranthus albus 6%.

Grass and small twigs, usually of buckbrush, were the most frequently used materials and the relative

FIGURE 6. Mourning dove tree nests at Coaldale, Alberta in July 1968.

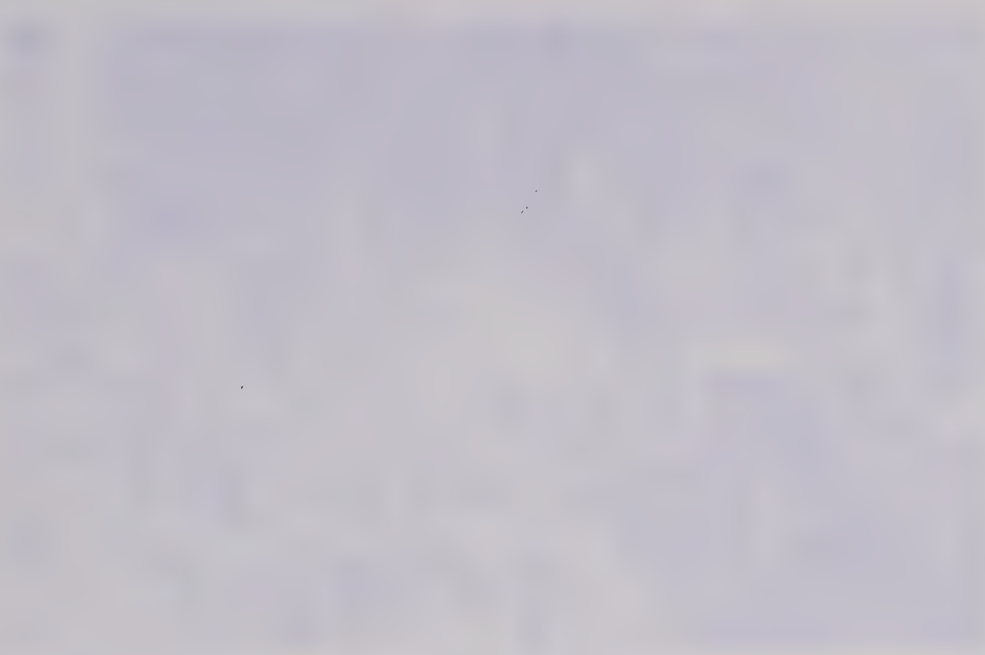


FIGURE 7. Mourning dove ground nests at Coaldale, Alberta in July 1968.

amounts of these in each nest appeared to be a function of the relative availability of each. In areas where the understory was predominated by buck brush it was also predominate in the nest and the converse was true in the case of grasses. Cudweed was extensively used in nests near areas which had been disturbed for gravel excavation and tumbleweed was frequently used on the southern periphery of the area where it collected against the base of trees, being blown here by wind.

Suitability of the substrate, in terms of security afforded, did not influence the amount of nesting material. Often nests in extremely precarious positions were composed of relatively little nesting material. On the other hand more secure substrates such as a crotch in a trunk or limb might contain abundant nesting material. The same was true of the concave shape of the nest in terms of protection afforded the eggs against rolling out.

Only one nesting cone (1%) was used. Presumably this was a secure site, however more nesting material was used here than in any other nest observed.

Nesting Sites

It is well documented that mourning doves are typically plastic in nest site selection. They are known to use a variety of positions in different trees as well as nesting on the ground. Table 3 presents the different substrates selected by nesting doves in this study. As in

Table 4 it does not include secondary nest use, that is dove nests built in old nests of other species. Secondary nest use has been excluded since it is possible that the pre-existing nest influenced site selection rather than vegetation. Table 3 does include reuse of old mourning dove nests since it is probable that vegetation influenced selection of the first nest and therefore these data are pertinent in discussion of the relationship between vegetation and nesting sites.

As may be noted by inspection of Table 3 the western cottonwood was most frequently used as a nesting site. During both years approximately 50% of all tree nests were found here. The narrow-leaved cottonwood was used half as frequently for both years. It may be noted that the narrow-leaved cottonwood was used relatively more in 1967 than in 1968 and the converse is true in the case of the western cottonwood. It is likely that this is a reflection of normal variation rather than a factor in the environment. Ground nests were the third most significant nesting site in terms of total number of nests. The fourth most important nesting sites are the peach-leaved willow and the lance-leaved cottonwood. The importance of these two species in comparison with ground nesting sites is particularily significant in terms of reproductive success. Other nesting sites found were the tops of two stumps, one willow, one saskatoon and three hawthorns.

TABLE 3. Percentage use of various nesting substrates by mourning doves in 1967 and 1968 at Coaldale, Alberta.

	Nesting Sites					
Year	Western cotton-wood	Narrow-leaved cotton-wood	Lance-leaved cotton-wood	Peach-leaved willow	Ground nests	Others
1967	36 n=20	26 n=15	13 n=7	9 n=5	11 n=6	5 n=3
1968	46 n=41	18 n=16	8 n=7	9 n=8	16 n=14	4 n=4
Total	42 n=61	21 n=31	10 n=14	9 n=13	14 n=20	5 n=7

To determine if time of the breeding season influenced site selection the per triad site utilization is presented in Table 4. The percentage use of each nesting site is calculated on the basis of the total number of nests per triad for each year. Because sample sizes are small during the third triad, discussion of this period is excluded. Moreover because sample sizes of nesting sites on some substrates are also small, care must be exercised in their discussion. However it would appear that the percent use of nesting substrates per triad does not vary radically from the total percent use, (Table 3), with two exceptions. One of these being use of the western cottonwood during the early summer of 1967, and the other the use of ground nesting sites during the spring period in 1968.

Secondary Nest Use and Nest Reuse

Secondary nest use is defined as the use by mourning doves of nests of other avian species. All secondary nests described in this study were those constructed in the previous year. Nest reuse is defined as use by mourning doves of another previously built mourning dove nest. These fell into two catagories, reuse of a nest constructed during the current season and reuse of a nest constructed in a previous season. These were simple to differentiate on the basis of wear and weathering of the nest material. Moreover if feces were present in the first nest weathering

TABLE 4. Percent use of nesting sites by mourning doves, presented on a per triad basis for 1967 and 1968 at Coaldale, Alberta.

Nesting Sites	May 7 - June 17		June 18 - July 29		July 30 - Sept. 2	
	1967	1968	1967	1968	1967	1968
Western cottonwood	45 n=16	40 n=18	27 n=4	47 n=17		60 n=6
Narrow-leaved cottonwood	22 n=8	14 n=6	27 n=4	19 n=7	60 n=3	30 n=3
Lance-leaved cottonwood	11 n=4	7 n=3	13 n=2	11 n=4	20 n=1	
Peach-leaved willow	8 n=3	14 n=6	7 n=1	6 n=2	20 n=1	
ground nests	8 n=3	23 n=10	19 n=3	11 n=4		
others	6 n=2	2 n=1	7 n=1	6 n=2		10 n=1
Total	63 n=36	49 n=44	27 n=15	40 n=36	10 n=5	10 n=10

of this was also a clue to the age of the reused nest.

Amount of nesting material used to construct a nest on top of another varied. Generally, however, material in reused nests did not observably differ from nests on other substrates. Usually the first nest simply served as the substrate of the second. Table 5 illustrates nest reuse and secondary nest use.

The relationship between robins, Turdus migratorius, and mourning doves is well documented by Nice (1922) and McClure (1943). Apparently in some areas robins provide empty nests and advance warning of predators. As may be noted in Table 5 only four doves, (2.7%), utilized robins' nests as platforms, even though they were one of the most abundant birds in the study area and provided many vacant nests for doves.

The availability of robins nests, black-billed magpie, Pica pica, nests and nesting cones and their disregard by doves indicates that the availability of suitable nesting substrates was not a limiting factor in the environment.

Fifteen dove nests were reused during the study, in both years the greatest number of these were from previous year's. Many workers use reuse of a current years nest as an indication of renesting by the first pair occupying the nest. As may be seen in Table 5 only two (3.5%) and (2%) fell into this catagory in 1967 and 1968.

TABLE 5. The incidence of nest reuse and secondary nest use at Coaldale, Alberta in 1967 and 1968.

	Secondary Use			Nest Reuse		
Nest type	Black-billed Magpie	Robin	Other	Previous year	Current year	Nesting cone
1967		1		3	2	
1968	2	3	1	8	2	1

Location of Nesting Sites

It is clearly shown in Figure 8 that certain portions of the study area were preferred nesting site locations, most notably the southern boundary. It was visually obvious that there was a difference in vegetational composition from south to north, however it was impossible to clearly delineate a demarkation between these areas. Therefore the study area was divided into three areas on the basis of site selection. Area A, the area of greatest use, area B, moderate use and area C, slight use. Natural features such as openings and trails were used to delineate these areas. Size of each area was calculated from aerial photographs and from transects. This and the number of nests per acre are presented in Table 6. Included in Table 6 is the abundance frequency and density of vegetation in the overstory. Species are listed in order of their abundance for each area.

Height of Tree Nests

It is clearly shown in Table 7 that the preferred height is between six and 15 feet where 62.5% and 52% of all tree nests were found in 1967 and 1968 respectively. An interesting feature of the height of tree nests in 1968 was the number of nests above 25 feet. It should be noted that all of these were in western cottonwoods. Since it is clear that the preferred height is about 10 feet the explanation for those above 25 feet may lie in two factors.

FIGURE 8. Location of mourning dove nests in the study area during 1967 and 1968 at Coaldale, Alberta. Included are the areas used for comparison of the overstory.

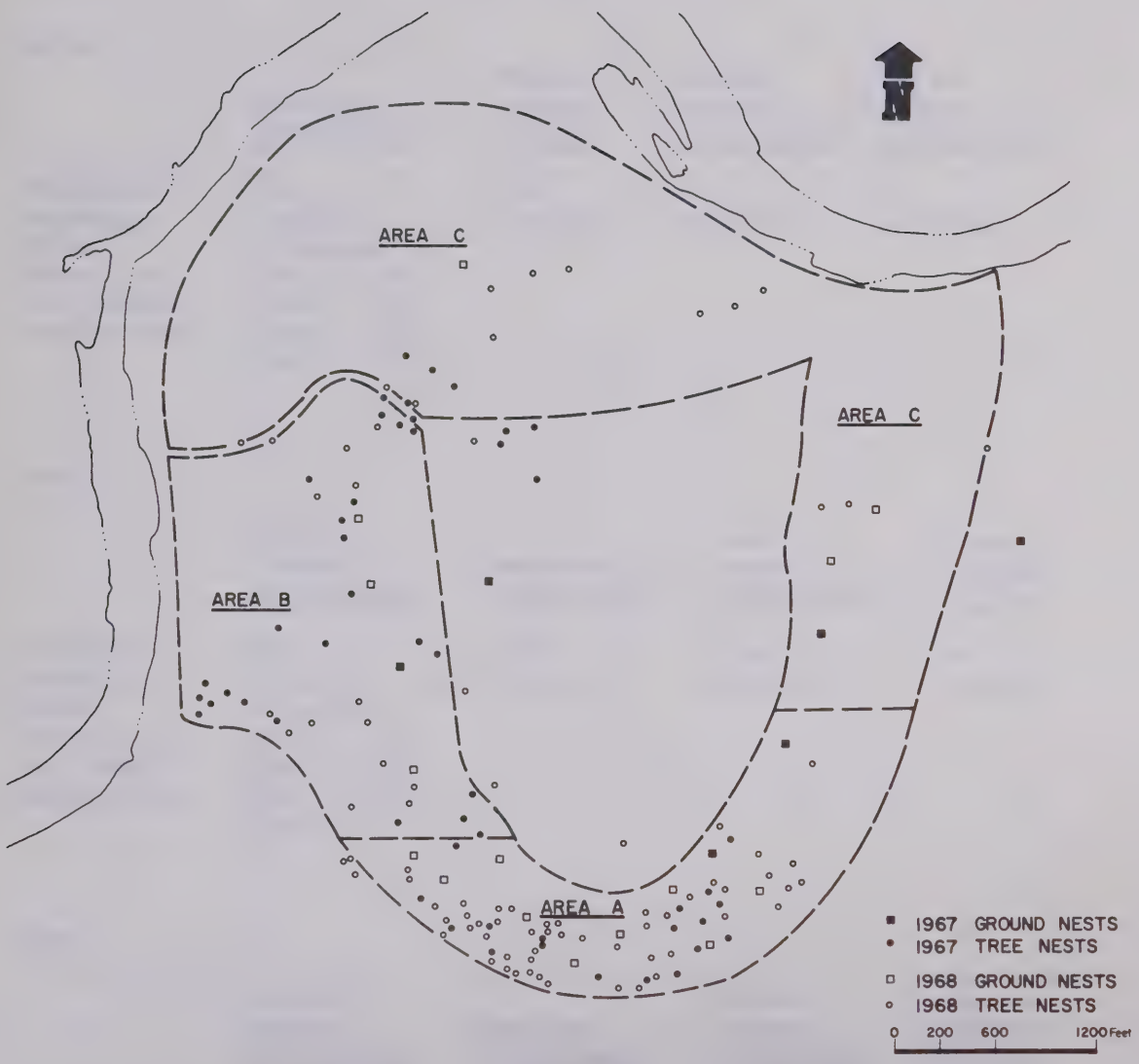

N
AREA C
AREA C
AREA B
AREA A
1967 GROUND NESTS
1967 TREE NESTS
1968 GROUND NESTS
1968 TREE NESTS
0 200 600 1200 Feet

TABLE 6. The vegetational composition of the overstory in three areas of the study area, and the use of each area by mourning doves in 1967 and 1968 at Coaldale, Alberta. Each species is listed in relative abundance from left to right.

Area A

	Western cottonwood	Peach-leaved willow	Narrow-leaved cottonwood	Lance-leaved cottonwood
Frequency	28%	10%	9%	3%
Density	.028/m^2	.012/m^2	.009/m^2	.003/m^2
Size	69 acres			
Total no. of nests	1967 = 20 1968 = 62			
nests/acre	1967 = 0.3 1968 = 0.9			

Area B

	Narrow-leaved cottonwood	Western cottonwood	Lance-leaved cottonwood	Peach leaved willow
Frequency	23%	14%	10%	4%
Density	.032/m^2	.017/m^2	.019/m^2	.004/m^2
Size	75 acres			
Total no. of nests	1967 = 26 1968 = 17			
nests/acre	1967 = 0.3 1968 = 0.2			

Area C

	Narrow-leaved cottonwood	Western cottonwood	Lance-leaved cottonwood	Peach-leaved willow
Frequency	24%	8%	4%	2%
Density	.037/m^2	.010/m^2	.004/m^2	.002/m^2
Size	150 acres			
Total no. of nests	1967 = 5 1968 = 14			
nests/acre	1967 = 0.03 1968 = 0.09			

First, this may be a reflection of normal variation in nest site selection and second, because of increased numbers of nesting pairs in 1968 preferred sites below 25 feet may not have been readily available.

Position of Tree Nests

In discussion of nest position Nice (1922) divided nesting sites into two catagories, nests on top of more or less horizontal branches and nests in crotches formed by division of the trunk.

In this study four positions were differentiated: nests on small branches against the trunk, in the crotch formed by division of the trunk, on top of a large limb or branch, and in the fork of a branch.

Obviously the relative security afforded as a substrate by any one of the above will vary with a variety of factors, nevertheless comparison sheds light onto the relationship of position and preference by nesting doves. Table 8 presents the positions selected excluding secondary and renesting attempts.

As may be noted the preferred position in Western cottonwoods and Lance-leaved cottonwoods was on top of limbs. This is probably explained by virtue of their growth form. They are the largest trees in the area, offering large horizontal branches. On the other hand lance-leaved cottonwoods and Peach-leaved willows are more foliose in shape with generally more slender vertically

TABLE 7. The height of 127 mourning dove nests at Coaldale, Alberta in 1967 and 1968.

Height in feet	Western Cottonwood		Lance-leaved Cottonwood		Narrow-leaved Cottonwood		Peach-leaved Willow		Total	
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968
0-5	0	0	1	0	1	3	3	0	5	3
6-10	9	11	2	5	4	11	2	3	17	30
11-15	6	4	1	1	5	1	1	5	13	11
16-20	2	9	2	2	2	2	0	0	6	13
21-25	2	6	0	0	3	1	0	0	5	7
26-30	1	11	1	0	0	0	0	0	2	11
30	0	4	0	0	0	0	0	0	0	4
	20	45	7	8	15	18	6	8	48	79
Range in feet	5.5 -28	5.5 -40	5- 30	6.5 -20	3.5 -25	2- 22	4.5 -11	6- 15	3.5 -30	2- 40

TABLE 8. The percentage of positions utilized by mourning doves at Coaldale, Alberta in 1967 and 1968.

Position	Western cottonwood	Lance-leaved cottonwood	Narrow-leaved cottonwood	Peach-leaved willow	Total
against trunk	15 n=9	14 n=2	32 n=10	14 n=2	19 n=23
in crotch of trunk	26 n=16	7 n=1	19 n=6	36 n=5	23 n=28
on top of limb	35 n=22	65 n=9	23 n=7	21 n=3	34 n=41
in fork of limb	24 n=15	14 n=2	26 n=8	29 n=4	24 n=29

directed branches.

Reproductive Success

Reproductive success is defined as the successful hatching and fledging of a clutch. Table 9 presents the total reproductive success of 154 tree and ground nests and Table 10 presents the same data by triads of the breeding season.

As may be noted in Table 9 reproductive success for both years was 55%, 64% in 1967 and 48% in 1968. In summarizing the results of 30 workers in 19 states, in eight geographical regions, Hanson and Kossack (1963) report a variation in reproductive success of 29% to 77%. The mean for the eight geographical regions was 57%. In their own study in Illinois they report reproductive success of 56.6% to 83.3% with an eight year mean of 65.9%. In Iowa McClure (1943) found a reproductive success of 55% and 44% in 1,108 and 1,443 nests respectively.

In habitat more similar to that of southern Alberta, Boldt and Hendrickson (1952) found a reproductive success of 58% in North Dakota. In the same state Randall (1955) reported reproductive success of two populations as 70% and 77%. In Nebraska McClure (1950) reported reproductive success of 48%. The mean for these studies conducted in the great plains was 63%.

The most noteworthy features of Table 9 are the consistent differences between years with reproductive

TABLE 9. Percent reproductive success of 154 mourning dove clutches in 1967 and 1968 at Coaldale, Alberta.

	Nest Site		
	Trees	Ground	Total
1967	61; n=51	100; n=6	64; n=57
1968	46; n=84	69; n=13	48; n=97
Total	51; n=135	79; n=19	55; n=154

TABLE 10. Percent reproductive success of 154 mourning dove clutches during triads of the breeding season in 1967 and 1968 at Coaldale, Alberta.

	Nest Site								
	Trees			Ground			Total		
Triad	1967	1968	total	1967	1968	total	1967	1968	total
May 7 - June 17	69;n=32	44;n=41	55	100;n=5	56;n=9	71	73	46	57
June 18 - July 29	64;n=14	42;n=32	49	100;n=1	100;n=4	100	67	49	54
July 30 - Sept. 2	0;n=5	50;n=10	33	-	-	-	0	50	33

success higher in 1967, and the difference between ground nests and tree nesting sites. These differences should also be noted in Table 10. As mentioned the first two triads are the most important in terms of clutch initiation and also from the point of view of reproductive success, as is evident in Table 10. It may also be noted in Table 10 that reproductive success did not vary significantly in the first two triads. Since few nests are initiated after July 30 this period cannot be compared with confidence to the other two. However it is reasonably evident that reproductive success is lower in this period

Egg loss and nestling loss are presented in Table 11 and they are calculated as percentages of total clutch failure. In 1967 60% of nest failure occurred in the egg stage and 40% in the nestling stage. On the other hand in 1968 this ratio was 75% to 25%. However in both years the greatest loss occurred in the egg stage.

Table 12 illustrates the causes of nest failure. In many cases these were difficult to determine as eggs or nestlings simply disappeared between two investigations without any evidence of the causative factors.

Predation was assumed when egg shell or nestling remains were found in or near the nesting site or when the nest had obviously been disturbed and this could not be related to weather. At no time was predation on mourning doves observed, however predation by black-billed

magpies on robins, and by long-tailed weasels on yellow shafted flickers, Colaptes auratus, was observed, and it is felt that these two species were likely the major predators of mourning doves. Hanson and Kossack (1963) say that Coopers Hawk, Accipiter cooperii, and the sharp-shinned hawk, Accipiter striatus, are the principle avian predators of mourning doves, however this was not corroberated during this study. They do think however that long-tailed weasels may be a major predator. In two cases a house wren, Troglodytes aedon, occasioned nest failure by pecking holes in dove eggs in the same tree they were using. Other predators which may occasionally prey on mourning doves are listed in the description of the study area.

Nest failure in nine cases was attributed to weather. The often precarious substrates and frailty of mourning dove nests is well documented, and the effects of strong wind storms occasioning nest destruction is likewise well documented (Cottam and Trefethen, 1968). In 1968 two clutches failed when the eggs fell out during strong winds. The remainder of the nest failures attributed to weather were caused by hypothermia in the nestlings.

Thermoregulatory problems of nestling doves are accentuated by flimsy nests and the lack of an adult brood patch. Moreover the feather coat is poorly developed up to about six days and the developing feathers consist largely of blood quills. Breitenbach and Baskett

TABLE 11. Egg and nestling loss in 154 mourning dove clutches at Coaldale, Alberta in 1967 and 1968.

	Egg Loss		Nestling Loss	
	No.	%	No.	%
1967	24	60	16	40
1968	65	75	21	25
Total	89	71%	37	29%

TABLE 12. Causes of clutch failure in 75 mourning dove nests at Coaldale, Alberta in 1967 and 1968.

	Unknown		Predation		Weather		Other Factors	
	No.	%	No.	%	No.	%	No.	%
1967	11	50	5	25	1	5	4	20
1968	24	45	17	32	8	15	5	9
Total	35	47	22	29	9	12	9	12

(1967) have shown that temperatures of 85°F cause increased oxygen consumption in six-and nine-day old doves, indicating thermoregulatory demands, and temperatures of 65°F were a challenge to nestling doves of any age. In a 65°F chamber doves below six days of age showed a 21-30°F drop in body temperature in one hour. It is not unreasonable to assume then, that cold wet weather accompanied by winds could create a heat loss situation which could be fatal to nestling doves.

In 1968 six clutches failed because of hypothermia. Starvation or abandonment was not the cause since the crops of the nestlings were full, or partially so, and in all cases some of the food was pigeon milk. Moreover in three cases the adults were brooding the dead nestlings. On the night of June 1, 1968, a ground nest on the side of a gravel slope failed through hypothermia. The position of the nest exposed it to prevailing winds and run-off from the slope, and on May 30 the temperature dropped to 41°F in the afternoon and remained so overnight. There was a trace of rain accompanied by gusty winds. On the morning of June 1 both nestlings were dead although the female was still brooding. The ages of the nestlings were two and three days respectively.

On June 29 and June 30 1.43 inches of rain fell, and the minimum temperature was 40°F accompanied by a steady wind of 15 miles per hour. These conditions

occasioned failure of five nests, in all cases the nestlings were six days of age or less. In three of these the adults were still brooding although the nestlings had been dead for several hours.

At no other time were dead nestlings found and this phenomenon was never noted in nestlings past six days of age.

On many occasions, the temperature dropped below $40^{\circ}F$ during the peak period of breeding, however, these were the only two occasions when wind and rain accompanied such a temperature drop.

In 1967, one nest failure was attributed to hypothermia, however, the conditions were not as clear, and abandonment may have been the cause.

The relationship of cover and reproductive success is presented in Table 13. If cover were important in protecting nesting doves from predation or weather one would expect a linear relationship to be evident. That such is not the case may be seen in Table 13.

The influence of height on reproductive success is shown in Table 14. It appears that the only nests above ground influenced by height are those below six feet. Above this height reproductive success is near the mean for the entire study. The only exception is those above thirty feet, however, at this height, the sample size is small.

TABLE 13. Percent reproductive success of 97 mourning dove clutches in relation to cover, in 1968 at Coaldale, Alberta.

% Cover	% Reproductive Success
0-5	71 n = 7
6-25	46 n = 28
26-50	48 n = 29
51-75	36 n = 25
76-95	50 n = 6
96-100	100 n = 2

TABLE 14. Percent reproductive success of 146 mourning dove clutches in six height catagories in 1967 and 1968 at Coaldale, Alberta.

Height in feet	% Reproductive Success
ground	79 n = 19
0-5	13 n = 8
6-10	51 n = 47
11-15	54 n = 24
16-20	63 n = 19
21-25	50 n = 12
26-30	54 n = 13
30-	25 n = 4

Table 15 presents reproductive success and position of nests in the various trees used. As may be noted, the position of the nest did not influence reproductive success, except in the case of nests found against a trunk in 1967. However this was not the case in 1968 when reproductive success for nests in this position was below the mean for that year.

TABLE 15. Percent reproductive success in four locations of the trees used by mourning doves in 1967 and 1968 at Coaldale, Alberta.

	Location			
	Against trunk	In Crotch of trunk	On top of limb	In Fork of limb
1967	89 n=9	53 n=15	66 n=15	55 n=9
1968	42 n=14	62 n=13	42 n=26	55 n=20
Total	61 n=23	57 n=28	51 n=41	55 n=29

DISCUSSION

Clutch Initiation and Clutch Size

In southern Alberta mourning doves arrive during the first two weeks of May and the timing of arrival is a function of spring weather. The major factor influencing onset of laying is apparently minimum environmental temperatures since the major period of clutch initiation does not occur until after the mean weekly minimum temperatures rise to the mid 30's F.^{o} This assumes that snow cover does not limit the availability of food. The period when initiation sharply increases has been considered as the "key week" in discussion of breeding. In 1967 very few clutches were initiated until the key week, however, in 1968 12% of all clutches were initiated before the key week. That 12% of all clutches were initiated prior to the key week in 1968 is of special interest since six (50%) of these were ground nests. Although Hanson and Kossack (1963) do not think foliage is a factor in influencing the onset of nesting it is possible that it may influence selection of ground nesting sites. Only 14% of all nests were ground nests for both years, however in 1968 when nesting began two weeks earlier than in 1967 50% of the nests in the first three weeks were ground nests. At no other time was this ratio of ground nests to tree nests evident. It is possible that the discrepancy between the temperatures and

the key weeks in 1967 and 1968 is explained by this fact. In 1967 arrival was delayed, and when the temperature rose all other factors in the environment were conducive to the onset of nesting. However in 1968 arrival was earlier and some factor in the environment must not have been conducive to stimulation of ovulation in the bulk of the breeding population. Since one half of the nests started prior to the major peak of clutch initiation were ground nests, the suggestion is that tree nesting sites were not suitable or else the females which would normally lay on the ground were not prevented by any factor in doing so. The foliage condition of the trees may thus play some role in nest site selection. Photoperiod is unquestionably important and this could explain the simultaneous rise of both major breeding peaks, however, not the clutch initiations prior to that time nor the high incidence of ground nests.

Breeding Period

It is well documented that mourning doves characteristically lay more than one clutch per year, consequently one would expect breeding period length to be longer than in species laying only one clutch per year. In 1967 if the last clutches would have been successful, fledging would have occurred sometime in the last week of September. In this year the last clutch was initiated two weeks later than the last clutch in 1968, which is in keeping with the difference between the beginning of laying for

both years. Therefore, for both years the breeding period was 14-16 weeks long. That is to say, clutches were initiated from the first week of May to the last week of August.

Although mourning doves renest, the breeding period in both years was characterized by only one major nesting peak which occurred during the last week of May and the first two weeks of June. In 1967 65% of all nest initiations occurred during this period and in 1968 38%. This difference may be explained by two factors. First, in 1968 12% of all nests were initiated prior to this period, whereas in 1967 only 2% of all attempts took place before it. The reasons for occurrence of this early peak in 1968 appears to be related to foliage condition. Second, in 1968 relatively more nesting attempts occurred after the main peak, than in 1967.

In 1967, after the major peak declined the percentage of clutches initiated stayed around 5% each week. On the other hand in 1968 a second peak was exhibited, during the second week of July. This peak came about one month after the major peak of that year.

As would be anticipated cumulative clutch initiation more rapidly approached 100% in 1967, than in 1968. The reason for this lies in the relatively greater percentage of clutches initiated early in the year in 1967 than in 1968.

Renesting

Data for determining the incidence of renesting can only be obtained with wild birds when a successful attempt was immediately followed by another attempt, the assumption being that the same pair was responsible for both clutches (Hanson and Kossack, 1963).

The length of time between initiation of a clutch and the second attempt is a function of the fate of the first nesting attempt (Hanson and Kossack, 1963). If the first attempt was successful the average interval is around one month. That is, the second clutch is initiated shortly after or during fledging of the first, (Hanson and Kossack, 1963; McClure, 1943; and Peters, 1961). On the other hand if the first clutch was a failure the time interval between its initiation, and initiation of the next clutch is a function of the fate of the first clutch. If the nest fails early in the cycle renesting is generally rapid, usually around six days (Hanson and Kossack, 1963). Conversly if failure occurs late in the egg stage or early in the nestling stage renesting does not occur as soon, usually requiring about two weeks.

The renesting interval is apparently a function of hormonal control of the breeding cycle. The ovarian follicle is stimulated by FSH (follicle stimulating hormone) and ovulation by LH (leutienizing hormone) and FSH (Rugh 1964). Apparently progesterone acts through a neural

mechanism to stimulate the anterior pituitary to release LH which induces ovulation (Sturkie 1965). This is somewhat enigmatic since production of progesterone and other gonadotrophic hormones is under the influence of LH (Bell, Davidson and Scarborough 1954). Therefore if the LH - progesterone theory is correct some feedback mechanism must exist whereby LH induces production of progesterone which induces further LH production which stimulates ovulation. Presumably then hormonal recycling necessary for ovulation does not take as long if a clutch fails shortly following its initiation than if failure occurs later in the cycle. This increased amount of time may simply be related to increased time necessary for preparation of the endocrine glands involved, or there may be a hormonal condition later in the breeding cycle antagonistic to rapid recycling. Hanson and Kossack (1963) state that doves are in a "broody" condition, immediately prior to hatching of their eggs and for seven to eight days thereafter. At this time the crop gland is in peak development, under the control of prolactin, which may inhibit production of hormones necessary for ovulation (Höhn, 1961). This is corroborated by Rugh (1964) and Welty (1962) who also say that prolactin suppresses ovulation. When the nestlings are about a week old production of pigeon "milk" decreases and so presumably does production of prolactin. Hence a dove in the broody state must wait until prolactin secretion from the

anterior pituitary abates and then another six or seven days elapses before the ovarian follicles mature and ovulate.

Only two pairs each year were found which initiated clutches in nests they had previously used that year. However this does not mean that these were the only renesting attempts as Hanson and Kossack (1963) report that renesting seldom occurs in the same nest when the first attempt was a failure. Also McClure (1943) reports that of nearly 3,000 nests observed in Iowa only 18% were used twice by the same pair, yet for the three years of his study, 1938, 1939 and 1940 each pair made 5.4, 5.1 and 4.6 attempts respectively. This indicates that most renesting occurs in new nests.

In 1968 there was a peak of nesting activity in the 2nd week of July. This is exactly one month after the major peak of nesting activity for that year, or the time required for completion of one clutch.

For the sake of discussion it will be assumed that all attempts following this date are renesting attempts and those preceding it first attempts. Even though some attempts after this date were likely first attempts and some preceding it renesting attempts. By adding the number of attempts in 1968 after this period a ratio of 61:36 first nesting to renesting attempts emerges.

On this basis one may calculate the number of

clutches attempted per pair by dividing 61 into 36. This indicates that each pair was responsible for 1.6 attempts in 1968. If June 18-24 is considered as the date when renesting began, then each pair was responsible for 1.8 attempts.

In 1967, if June 25 is considered the point after which all attempts are renesting attempts then, a ratio of 41:16 initial to renesting attempts results. Which means each pair was responsible for 1.4 nesting attempts.

Theoretically since the breeding period is almost four months long, four attempts by one pair are possible. McClure (1943), however, indicates that where the breeding period was six months long only five attempts by one pair was ever observed. Therefore it is not unlikely that most pairs which renested in this study only renested twice. It is suspected, however, that one female in 1967 was responsible for three attempts. In this case one nest was reused 30 days after successful completion of the first clutch. Hanson and Kossack (1963) report this phenomenon, and feel it may be explained by successful completion of a second clutch elsewhere and a subsequent return to the initial nest for a third attempt.

In relating renesting to triad of the breeding period the first triad is composed almost entirely of first attempts and the remaining two of renesting attempts.

Nesting Sites

The western cottonwood is the most important tree in terms of nesting sites. This is of significance as this species often predominates in river bottoms in southern Alberta. Whether mourning doves choose western cottonwoods or whether the choice is determined by some other factor is of interest. It is well documented that mourning doves prefer open locations on the edges of wooded areas, (Hopkins and Odum, 1953; Peters, 1961). Apparently this is related to the nest site itself which is usually selected on a substrate offering good visibility (McClure, 1943). The western cottonwood is the predominate tree in the southern part of the study area. It is definatively larger than any other tree in the area, with larger branches and subsequently the density of this area is less than in other areas (Table 6). Moreover the understory in this area is also generally light consisting primarily of grasses (Figure 9). The preferred area is thus one in which the understory and overstory are open. Consequently since western cottonwoods predominate in this area, and their growth form most suitably provides the dove with a nesting site, they are the most frequently used tree. The narrow-leaved cottonwood was the next most frequently used site, probably because of its abundance throughout the study area. Ground nests are the third most important site. The other nesting sites used are the lance-leaved

FIGURE 9 The southern part of the study area, predominated by western cottonwoods, and most frequently used by nesting doves at Coaldale, Alberta in 1967 and 1968.

cottonwood and the peach-leaved willow. These were only half as important as the narrow-leaved cottonwood and one quarter as important as the western cottonwood. Apparently this is because they are less frequently encountered than either other species and moreover where they predominate the overstory and understory is quite dense.

The use of each nesting site does not vary through the breeding season, except in the case of ground nests, and this has been discussed.

Although vacant nests of other species, plus nesting cones, were available, the doves disregarded them in favor of new sites. This indicates that availability of nesting sites is not a limiting factor in this ecosystem, and that doves prefer to build nests on unused substrates if they are available. Also the relationship between robins and doves is evidently unimportant at Coaldale.

The preferred height of tree nests was found to be about 10 feet. Territoriality could account for sites selected well above this height, since males defend cooing perches over a large area, (Calhoun, 1948; Jackson and Baskett, 1964). However, once nesting has occurred, the territory is reduced to a few feet in size (Jackson and Baskett, 1964; Swank, 1955). Although nesting at the Coaldale study area was hardly colonial certain areas were preferred and

what might be termed nesting concentrations were found. It is not unreasonable to assume, that the dove is not strongly territorial, and hence dominant behavior of already established birds would not force selection of a site which otherwise would not be selected. That this was so in this study, is indicated by three nests which were initiated within a two day period, and no nest was further than 15 feet from the other.

McClure (1943) states that preferred nesting sites are flat, horizontal and without obstruction upward or downward. These sites are consequently not well protected against predators and storms. In this study positions on the top of large and more-or-less horizontal, limbs were the preferred sites. Availability of this nesting site in species other than the western and lance-leaved cottonwood is reduced because of their growth forms.

Reproductive Success

The reproductive success and annual variation of it observed in this study were similar to those of other studies.

One of the most notable features was the marked success of ground nests compared to those in trees. This was consistent for both years, and for both triads in which ground nests were active. It may thus be concluded that under the environmental conditions at Coaldale ground nests are more successful than those in trees. Success may be attributed to the fact that both parents incubate

and brood, therefore the nest is rarely unoccupied. Also the nestlings do not exhibit vocal food begging behavior which might otherwise attract potential predators. Furthermore, a ground nest is not as exposed to destruction from weather as are tree nests. Some ground nests however, have little cover but the coloration of the adult makes them inconspicuous whereas this does not as readily apply to tree nests.

Reproductive success for the first two triads, May 7 - July 29 did not show significant differences. From this, one may conclude that changing foliage condition of the area did not influence success, that pressure from the total factors causing failure did not change during the first two triads and that renesting attempts were as successful as initial attempts. The number of clutches initiated in the last triad, i.e. July 30 - September 2, is small but it appears that reproductive success in this period is significantly lower than the previous triads. In 1967 three of the nests initiated during the last triad were abandoned. During this period, incubating and brooding adults appeared to be more wary, and often left the nests unattended. It is possible that the impending stimulus to migrate was conflicting with nesting behavior, resulting in lessened concern for eggs or nestlings at this time.

The greatest loss occurs during the egg stage, and

this was found in both years. McClure (1950), Cowan (1952) and Quay (1951) also found egg loss to be greater than nestling loss. In most other nidicolous species, egg and nestling loss are about equal (Lack, 1954; Ricklefs, 1969). This may in part be explained by the unobtrusive behavior of the nestlings and the production of "pigeon milk" by the adult, which means the brooding adult is not as frequently obligated to leave the nest. This assumes that the longer a nest is active, the greater its chances for success if factors associated with the nestlings do not increase the probability of predation.

Quay (1951) states that the least known factors of mourning dove biology are the causes of nest failure. In the present study the largest catagory of nest failure was attributed to unknown factors. Lack (1954) discusses unknown egg and nestling loss and attributes almost all of this loss to predation. In this study where predation was definitely suspected most of it was attributed to black-billed magpies and long-tailed weasels.

Nest failure occasioned by wind storms has been reported by others, however, in this study only two nests failed through wind loss even though the area was periodically subject to high winds. On the other hand, hypothermia was more significant and caused failure of six nests. This loss is relatively small, however, in terms of total nest failure.

Neither cover nor the nests position were of import-

ance with regard to the eventual success of the nest. Height was shown to influence reproductive success only in tree nests below six feet. This indicates that discovery of a dove nest by a predator occurs by chance. Therefore, no particular nesting segment of the population is selected against by predators. It follows that the doves plasticity in nesting is an advantage, preventing the development of a "hunt pattern" by any given predator.

Productivity

There are two problems in consideration of productivity in mourning doves. Reported estimations of first year survival varies, and the reported number of renesting attempts also varies. Normal variation of these two factors would of course exhibit annual changes in any given area. However, over a long term period one must assume some constant in order to predict productivity.

That first year mortality exceeds adult mortality is well established (Lack, 1954). In mourning doves Quay (1954) reports that juvenile mortality is about 85%, Austin (1951) places it at 80%, however, Hanson and Kossack (1963) state that it is around 60%.

Adult mourning dove mortality is slightly greater than 50%. Lack (1954) states that the most reliable data on adult mortality is found in Austin's (1951) and Hickey's (1952) work, who place annual adult mortality at 55% and 56%. Hanson and Kossack (1965) place it at 51%. From

these data, one can estimate the number of renesting attempts necessary to support a population if reproductive success is known. The most extensive review of reproductive success is to be found in Hanson and Kossack (1963) who summarize the results of 31 studies. The mean reproductive success in these studies is 55%. The number of renesting attempts necessary to support a population with a mean reproductive success of 55%, adult mortality of 55%, and juvenile mortality of 80% may be calculated as follows. Of 100 pairs of breeding adults, only 45 will survive to the next season, therefore, they must produce 110 juveniles, or 55 pairs, which survive for a year to compensate for this loss. If the juveniles they produce suffer 80% mortality and 110 must survive for a year, then 550 must have fledged. If reproductive success was 55%, then 1,000 eggs must have been laid. This means that each pair must have made around five nesting attempts.

McClure (1943) reports that the average number of clutches attempted in 1938, 1939 and 1940 in Iowa was 5.4, 5.1 and 4.6 respectively. In North Carolina, Quay (1954) states that three clutches per year is a conservative estimate. Peters (1949) states that over most of the mourning doves range three clutches per pair is a realistic figure, and Fichter (1959) states that three attempts per pair are maximum in the doves range in the northern United States. Hanson and Kossack (1963) report an average

of two attempts per pair.

Since the dove is successful over most of its range and in fact, has been extending its range, a juvenile mortality of 80%, which implies five attempts, is probably high. Consequently to calculate productivity in southern Alberta 60% juvenile mortality is used. This is the lowest mortality figure which has been reported.

In 1967, reproductive success was 64% and each pair was responsible for 1.4 clutches. 57 clutches were initiated, therefore, 57÷1.4 or 40 pairs were present and they produced 72 fledglings. Therefore, each pair produced 1.8 fledglings.

In 1968 reproductive success was 48% and each pair was responsible for 1.7 clutches. 97 clutches were initiated, therefore, 97÷1.7 or 57 pairs were present and they produced 93 fledglings. Therefore, each pair produced 1.6 fledglings.

On this basis one may calculate the productivity of the Coaldale population as is done in Table 16.

From these data it may be seen that the Coaldale population is not self-sustaining. The reproductive success recorded and number of nesting attempts recorded indicate that each year a deficit of approximately 15% incurred. Yet in 1968, the breeding population increased from 40 pairs in 1967 to 57. This leads one to surmise that immigration of doves from another area yearly augments

TABLE 16. Calculated productivity of mourning doves at Coaldale, Alberta in 1967 and 1968.

Number of adults	200 (100 pairs)	
	1967	1968
Average number of nesting attempts/pair	1.4	1.7
Potential production of young (clutch size = 2)	2.8	3.4
Reproductive success	64%	48%
Potential young per successful nest	1.79	1.63
Production per 100 nests	179	163
Number of adults returning the following year (50% mortality)	100	100
Number of juveniles surviving to return the following year (60% mortality)	72	65
Total breeding population following year	172	165
	(86 pairs)	(82.5 pairs)

those returning to Alberta. Since the dove has been expanding its range, it is not unreasonable to assume that birds hatched further south join this population on the spring migration.

It can be calculated that the highest annual juvenile mortality which would allow maintenance of the population is 44% in 1967 and 39% in 1968, figures well below those reported by other workers.

In the introduction to this paper it has been hypothesized that the factor limiting northward expansion of mourning doves must be associated with latitude, above which the breeding season is sufficiently shortened that the number of renesting attempts is similarily reduced to the point where annual mortality exceeds natality.

The close agreement between the reproductive success found at Coaldale and that of other areas indicates that this parameter does not vary with latitude and is not involved in this consideration.

Annual adult and juvenile mortality, used in this calculation are the lowest figures reported in the literature. It is probable that in reality both are slightly higher, particularily since mourning doves from southern Alberta undergo longer migrations and are likely, exposed to higher mortality on migration than doves starting farther south.

Thus it may be concluded that mourning dove dis-

tribution in Alberta is limited because of a shortened breeding season at latitudes above 50^{o}, and that reproductive success is normal even though additional stress such as hypothermia is superimposed on other factors causing failure.

Moreover it may be concluded that maintenance of any Alberta population is dependant upon immigration of doves raised farther south.

HUNTING

Status of Mourning Doves in the United States

Historically mourning doves were probably not subject to extensive exploitation because of their small size and solitary nesting habits. However, Bent (1932) reports that mourning doves have been hunted at least since the turn of the century in the southeastern United States. Peters (1961) estimated that in 1949, 15 million doves were taken in the United States and in 1955-56 19 million. In light of this it is curious that little research into mourning dove management was undertaken until 1948 when its increasing importance induced the Southeastern Association of Game and Fish Commissioners to embark on a co-operative study which included ten states in this region by 1949.

Today more mourning doves are killed in the U.S. than any other upland species or than all waterfowl combined. Peters (1961) estimates the harvest of 1960 to consist of nearly 30 million doves. Consequently from the point of view of economics and recreation the mourning dove is probably the most important game bird in the U.S. This is particularily so in light of reduced duck limits and dwindling pheasant populations.

Importance of the mourning dove as a game bird varies from region to region. It would appear that this is a reflection of relative abundance and hunter interest. Since migration of the immatures in the northern states

occurs prior to the earliest opening date (Sept. 1) of the hunting season, (Hanson and Kossack, 1963; McClure, 1943; Newson et al, 1953), areas situated within the wintering zone have higher harvests. Edminster (1954) reports that states with the highest harvest are California, Texas, Oklahoma, Tennessee, Kentucky, Georgia, and Alabama. In 1960 the California kill was estimated at 3.5 million doves, (Anon., 1960) or approximately 10% of the total estimated by Peters (1961) for the same year.

Gallizioli (1961) thinks that presence of alternate game bird species can also influence the importance of mourning doves as a game species. For example in Arizona in 1959, 40% of 42,000 licensed hunters killed 900,000 mourning doves while in Washington 23,000 hunters or 8% of the licensed hunters took 285,000. In Arizona there are only two other upland species of importance, the white-winged dove (Zenaida asiatica) and Gambel's quail (Lophortyx gambelii). On the other hand ring-neck pheasants (Phasianus colchicus), chukar partridge (Alectoris graeca), band-tailed pigeons (Columba fasciata), grouse, and quail are available to the upland bird hunter in Washington.

Management and Related Problems

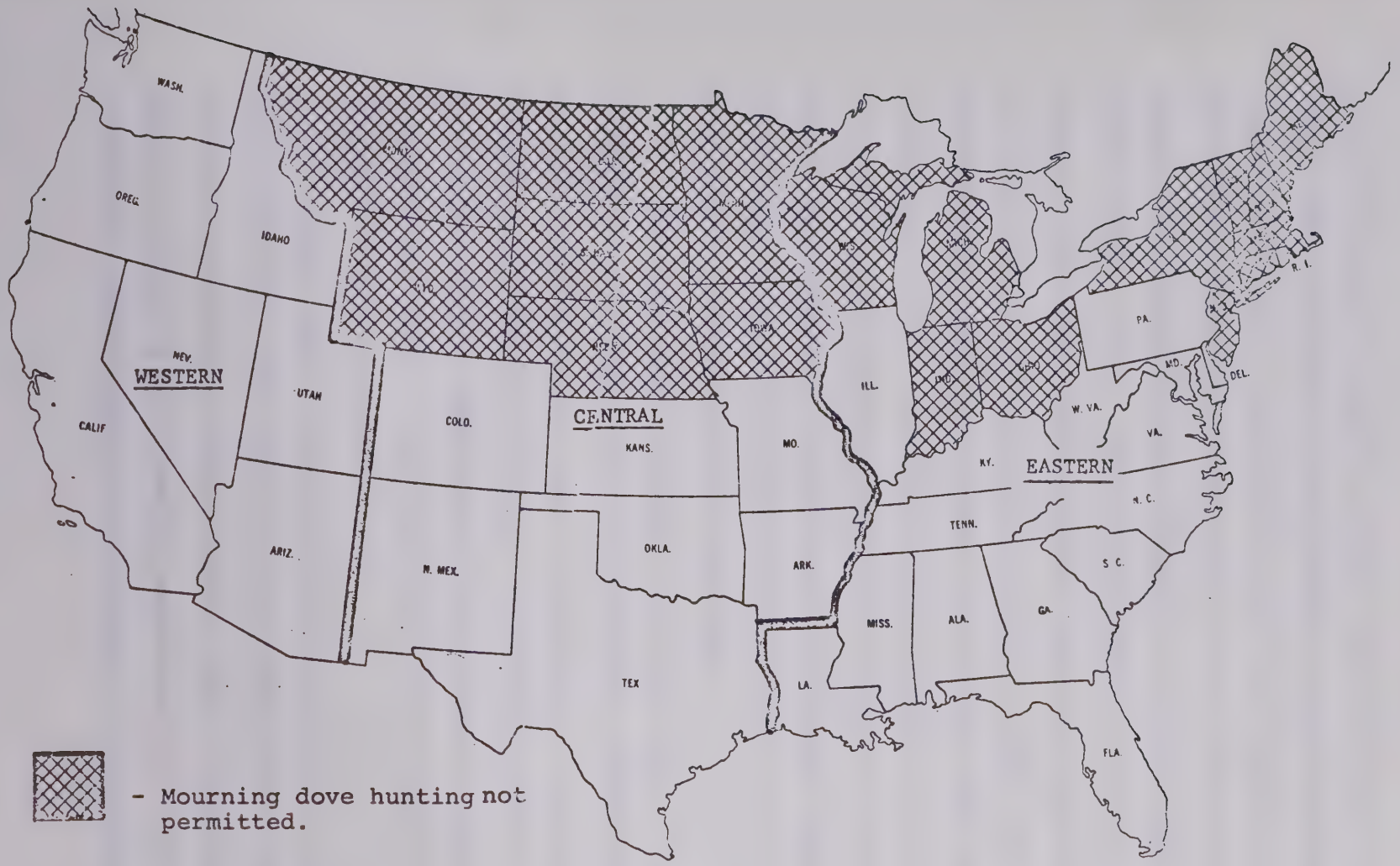
Management of the mourning dove, a migratory species exhibiting widely varying characteristics of abundance and migratory movements is complex in an area as large as the United States. Obviously management could be administered

more effectively in smaller units and consequently three management units (Figure 10) were adopted, based on banding data collected from 1953 through 1957. Ideally a management unit is a unit that produces the doves it harvests and does not produce doves harvested in other units (Keil, 1959).

Since management units are based on banding returns the following errors may be inherent in their formation (Kiel, 1959): distribution of banding does not always represent the distribution of dove populations, unmeasured biases in the call count census and possible variation in productivity between management units obscure the relation between the breeding index and the actual population, and little is known of the regional variation with regard to reporting bands found on shot birds.

Consequently current management consists almost entirely of regulating the harvest by determining population trends based on the call count or coo-count survey. This technique is based on work done by McClure (1943) which was subsequently refined by Foote et al. (1952) and is currently the only available index to dove populations (Tomlinson, 1965; Stone, 1966). Each route is 20 miles long with 20 listening stations located one mile apart. Call counts begin one half hour before sunrise and continue for two hours. A record is kept of all doves seen or heard calling at each station during a three minute interval, and

FIGURE 10. Mourning dove management units in the United States showing where hunting is permitted. (After Tomlinson, 1965).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- Mourning dove hunting not permitted.

of all doves seen along the route. However, only the number of doves calling at each station are used to determine population trends. Individual counts are conducted each year on the same route between May 20 and June 10 as research has indicated that calling is at a peak during this period (Stone, 1966). Since early routes were often in areas of high dove populations and thus not representative of a regions entire breeding population, routes have been selected at random in an attempt to eliminate this bias (Tomlinson, 1965). Data from several states are combined to give breeding indices by applying a weighting factor. This is accomplished by multiplying the average number of doves heard calling per route in each state by the estimated area of dove habitat in that state.

The call count technique has been subject to a variety of criticisms. As in all auditory census methods validity and reliability may be a function of personal experience and hearing ability. Inaccuracies caused by human error may in large measure be overcome by practice, but those inherent in characteristics of dove populations are not as easily resolved.

Since female doves do not coo as audibly or as frequently as males, the males are the segment of the population most frequently counted (Stone, 1966). Therefore to obtain an index of the breeding population the proportion of mated to unmated males must be known. Furthermore

Frankel and Baskett (1961) and Jackson and Baskett (1964) have shown that unmated males call more frequently than mated ones. Consequently differential calling behavior, between males and females, and between mated and unmated males makes the call count technique liable to serious error, particularily if sex ratios vary.

It would seem reasonable to assume that nesting success and mortality, after the coo-count and before the hunting season, would vary annually. Hanson and Kossack (1963) have reported a variation in nesting success from 57% to 83% for the years 1950 through 1958 in Illinois and other workers report similar variations. Little information is available on mortality prior to the hunting season, but it seems unreasonable to assume that immature and adult mortality caused by predation, disease, weather and other factors, or any combination thereof would be constant yearly.

Stone (1966) states that although coo-counts are currently used as indicators of fall population levels, and are administratively treated as such, the relationships have not been clearly established. Moreover the count is conducted when the breeding season has only begun and does not attempt to measure breeding populations when secondary nesting is underway. This is probably a serious omission, since part of the doves success is due to secondary nesting, particularly in areas in the southern United States.

In essence the hunting season is established on the grounds of potential production, which for the above reasons may or may not be indicative of fall, or huntable populations. Nevertheless the coo-count is the only presently available method of determining mourning dove population trends.

Another major management tool is banding and the purpose and some of the problems of this approach have been mentioned. Besides establishment of management units banding yields data on harvest rates in different areas and between doves banded as adults, immatures and nestlings. A prolonged banding program also yields data on migration patterns, mortality rates, and the source of doves harvested in a given region. Currently most doves are banded as nestlings and Kiel (1960) thinks that emphasis should be shifted to adults, since survival of nestlings through to the hunting season is low. He also suggests that banding of distinct populations before and after the hunting season would permit a more accurate estimation of hunting mortality.

Data from banding returns suffers from insufficient numbers of birds banded and a generally low return of bands. Recovery rates are twice as high in states allowing hunting than in states where doves are not hunted (Kiel, 1959). In the eastern management unit band recovery rates in 1953 to 1957 in states where doves were hunted were: adults 3.9% and immatures 5.7%. On the other hand in the same unit and

period in states where doves were not hunted a return of 1.1% and 1.1% was found (Kiel, 1959).

Present estimates of the harvest are only done on a state to state basis and since the dove encounters a host of different situations a continental hunting summary is difficult to form. It is possible that total kill estimates are exaggerated and should be viewed with some scepticism. Hanson and Kossack (1963) state that the current total kill estimates may be in error by a magnitude of two to four. They suggest that hunters have a propensity to exaggerate and that only the more successful hunters return kill cards.

Age ratios of mourning doves collected from harvest data are calculated using the stage of primary moult as the criterion. These are useful in determining reproductive success and age structure of a population only if the following assumptions are true (Hanson and Kossack, 1963): that the various age components of the population are still present in the hunted area, that all age components are equally vulnerable to the hunter, and that if one age group is particularily vulnerable as shown by band recoveries, corrections can be made to compensate for the differential. It is unlikely that these conditions are ever met in practice as there is a differential migration between immatures and adults.

The crux of what hunting loss means to dove popu-

lations must ultimately be determined on the basis of recoveries of all banded doves raised in a hunted area, an ideal situation unlikely to be achieved. This criticism not withstanding, Peters (1961) has estimated that 70-90% of the hunter's bag, determined by ageing at check stations, is comprised of birds of the year.

The only pathogenic organism considered to have an occasional impact on dove populations is Trichomonas gallinae although others such as pox caused by a virus and a protozoan disease, Coccidiosis, have caused small local losses (Kiel, 1960). In the early 1950's Haugen (1952) reported an outbreak of Trichomoniasis in Alabama which he considered severe enough to term epizootic. He claimed that it was the cause of the lowest breeding population reported in ten years.

Pesticides are not likely to effect mourning dove populations, primarily because of the doves position in the food chain. Moreover Dahlen and Haugen (1954) have shown doves to be three times as resistant to aldrin, dieldrin, toxaphene, and lindane than bobwhite quail, Colinus virginianus, and that levels below those causing acute toxicity did not alter reproductive success. However the potential for mercury poisoning from injested grain should not be neglected as mourning doves may have access to treated grain in the spring.

Other management problems are not related to the

biology of the mourning dove, and would more aptly fit in the catagory of public relations. They have been referred to as the "song bird controversy" and the "nestling controversy". Under the Migratory Bird Treaty of 1918 between Canada, the United States, and Mexico the mourning dove is classified as a song bird. This has engendered a game-bird-songbird controversy which has been strongest in states where hunting is prohibited. In the 30 states permitting a season in 1960 only seven experienced opposition to the season. On the other hand, in 18 states where hunting was prohibited, 12 had or were experiencing opposition (Kiel, 1960). From this, one may conclude that there is stronger opposition to the opening of a season than for closure of a presently existing one. Apparently there is acceptance of the dove as a game bird in states with a tradition of dove hunting, which is likely a reflection of hunter interest. Opposition has, in most cases, come from local bird clubs and other conservation oriented groups.

Besides using the song bird classification as an argument these groups have used the fact that doves may still be nesting during the hunting season. In areas in the southern U.S. this is certainly true, however, opening dates of the season there may be delayed to allow for late nesting.

The crippling loss, which may approach 35% of the kill (Hanson and Kossack, 1963; Edminster, 1954), the size

and generally peaceful image the dove evokes have also been used as arguments against the dove hunting season.

Arguments against a dove season are difficult to resolve biologically since they are essentially emotional in nature. However a bird is a song bird by legislation and not by nature and this does not make a species less enjoyable to hunt nor alter the economics associated with the hunting of it. As far as the "nestling" controversy is concerned only a few birds are still nesting during the hunting season and research has shown that crop thickening does not necessarily indicate that a dove was brooding when taken (Caldwell, 1957). The only valid arguments for or against a hunting season should be based on sound biological evidence. Consequently the arguments against a dove season are not valid in areas where dove populations have been shown to be able to sustain an annual harvest.

Since dove populations are evidently not declining and are in fact expanding their range the present hunting pressure does not likely have an effect on the continental dove population.

On the other hand arguments for extended seasons and increased bag limits are also untenable in the absence of biological evidence for their increase. Moreover because members of a population die of causes other than hunting it does not follow that these individuals are wasted and should be taken by hunters.

Hunting In Canada

To date only Ontario and British Columbia have had open seasons on doves. In Ontario the season was open for one year, and was subsequently closed because of public pressure against it (Lansdowne and Livingstone, 1968). In British Columbia there is currently an open season on mourning doves and in 1969 the Canadian Wildlife Service estimated that 3,663 doves were taken (Anon., 1970).

Although the mourning dove is an important game bird on a continental scale it is clearly not so in Canada. The reasons for this are that it is locally common only in the southernmost part of Canada, and migration of birds of the year occurs prior to September 1. Hunter interest may also be slight in areas where there are other more numerous huntable species.

Feasability of Mourning Dove Hunting in Alberta

The management of a migratory game bird is immeasurably more complicated than for a sedentary species. In Alberta there are further complications as this area is on the northern periphery of the doves range, moreover the dove is a recent invader and there is no knowledge of previous population dynamics in this region.

It has been shown that the Alberta population must rely upon birds raised in other areas to maintain their population at this latitude, and that the major factor limiting northern expansion is the length of the breeding

season.

Although band return data is based only on one band, returned from a hunter at Napa, California, it is likely that doves raised here are exposed to hunting during most of their southern migration.

Consequently the picture that emerges is one of a population on the periphery of the species range, augmented yearly by birds raised further south, and which is exposed to hunting pressure on its southward migration.

Although mourning doves are common in a few localities in southern Alberta, they are not generally so. The largest breeding populations were found at the Coaldale study area and on the Milk River south of Formost and Manyberries. However the latter two areas are accessable only by foot and are not near population centers. To the casual observer they may at times appear extremely abundant, particularily during early August when the immatures are flocking. Their habits of feeding and picking up gravel, on or adjacent to roadways, and roosting on fences and telephone wires could also give an impression of abundance.

Since the earliest opening date for a hunting season is September 1, and migration of immatures occurs in mid-August, the mortality from hunting in Alberta would consist chiefly of adults which constituted the spring breeding population. It has been shown that doves partic-

ularily the adults, exhibit site tenacity and return to breed in areas where they were raised (Hanson and Kossack, 1963; Quay, 1954). It has also been shown that the highest mortality is in the first year. Therefore a hunting season would select against the segment of the population, the adults, whose chances of returning to southern Alberta would otherwise be the greatest.

The definition of game management, "the act of making land produce sustained annual crops of wild game for recreational use," coined in 1933 by Aldo Leopold has not been improved upon. The production of sustained annual crops is the primary goal of game management in general, and must be commensurate with conditions existing in any given area.

Obviously this definition of game management is not commensurate with the status of the mourning dove in Alberta as the population is not self sustaining even without the additional mortality of local hunting. Superimposed on this, the hunting harvest in Alberta would take the breeding adults of the current year. Moreover doves are admittedly common in southern Alberta, and are certainly not endangered, but they do give the impression of being more abundant than they are.

Although the author does not adhere to the argument that a huntable species left unharvested is wasted, this argument is not valid in Alberta because management of a

migratory species cannot be viewed on a local basis, but rather must be considered on a continental one, without consideration of political boundaries. Since Alberta doves are being harvested in the United States they are in fact not being wasted.

Although the dove has been traditionally hunted in the United States, its management is not adequately sensitive and refinements must be made. In Alberta, the juveniles which would normally comprise the bulk of the harvest, migrate two weeks prior to the earliest legal hunting date. Therefore to make a mourning dove hunting season practical the Migratory Birds Convention Act would have to be amended. The politically dangerous prospect of such an amendment, for harvest of a small, restricted population, would be unwise. I therefore do not advocate that a hunting season on mourning doves be established in Alberta.

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APPENDIX 1

The resident birds of the summer in the study area at Coaldale, Alberta. A single asterisk denotes species for which nests were not found but adults were seen with nesting material or food or otherwise indicated they were nesting or resident. A double asterisk denotes birds seen during the middle of the summer which were probably not resident. (Migrating species are not included).

1. Mallard. Anas platyrhynchos
2. Red-tailed Hawk. Buteo jamaicensis
3. Marsh Hawk. Circus cyaneus
4. *Pigeon Hawk. Falco columbarius
5. Sparrow Hawk. Falco sparverius
6. Ring-necked Pheasant. Phasianus colchicus
7. Grey Partridge. Perdix perdix
8. Killdeer. Charadrius vociferus
9. Mourning Dove. Zenaidura macroura
10. Black-billed Cuckoo. Coccyzus erythropthalmus
11. Great Horned Owl. Bubo virginianus
12. Common Nighthawk. Chordeiles minor
13. Yellow-shafted Flicker. Colaptes auratus
14. **Red-headed Woodpecker. Melanerpes erythrocephalus
15. *Downy Woodpecker. Dendrocopos pubescens
16. Eastern Kingbird. Tyrannus tyrannus
17. Western Kingbird. Tyrannus verticalis
18. *Least Flycatcher. Empidonax minimus
19. Western Wood Pewee. Contopus sordidulus
20. Horned Lark. Eremophila alpestris

Appendix 1 continued

21. Black-billed Magpie. Pica pica
22. Black-capped Chickadee. Parus atricapillus
23. House Wren. Troglodytes aedon
24. *Catbird. Dumetella carolinensis
25. Brown Thrasher. Toxostoma rufum
26. Robin. Turdus migratorius
27. **Mountain Bluebird. Sialia currucoides
28. Cedar Waxwing. Bombycilla cedrorum
29. *Loggerhead Shrike. Lanius ludovicianus
30. Starling. Sturnus vulgaris
31. Red-eyed Vireo. Vireo olivaceus
32. *Warbling Vireo. Vireo gilvus
33. Yellow Warbler. Dendroica petechia
34. *Yellowthroat. Geothlypis trichas
35. Yellow-breasted Chat. Icteria virens
36. **American Redstart. Setophaga ruticilla
37. House Sparrow. Passer domesticus
38. Western Meadowlark. Sturnella neglecta
39. Baltimore Oriole. Icterus galbula
40. **Bullock's Oriole. Icterus bullockii
41. Brewer's Blackbird. Euphagus cyanocephalus
42. Brown-headed Cowbird. Molothrus ater
43. *Rufous-sided Towhee. Pipilo erythrophthalmus
44. Savannah Sparrow. Passerculus sandwichensis
45. Vesper Sparrow. Pooecetes gramineus

Appendix 1 continued

46. Lark Sparrow. Chondestes grammacus

47. Chipping Sparrow. Spizella passerina

48. Clay-colored Sparrow. Spizella pallida

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